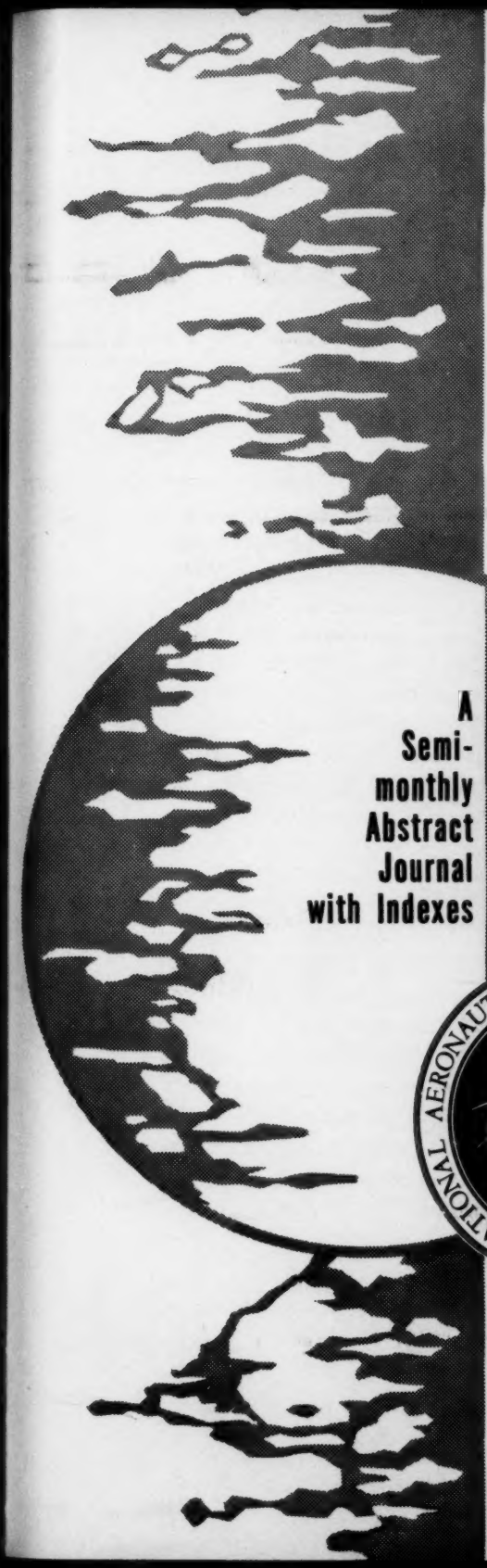

Scientific and Technical Aerospace Reports

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A Semi-monthly Abstract Journal with Indexes

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION U.S.A.

April 23, 1963

VOLUME 1 NUMBER 8

N63-13326—N63-13785

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Use of funds for printing this publication approved by the Director of the Bureau of the Budget, December 20, 1962

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For related information see: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; and 11 Fluid Mechanics

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A Semimonthly Publication of the National Aeronautics and Space Administration

April 23, 1963

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Includes: management; space law and legal matters; symposia or conferences of a broad or a general nature.

N63-13355 Illinois U. Coordinated Science Lab., Urbana

PROGRESS REPORT FOR SEPTEMBER, OCTOBER, NOVEMBER, 1962

H. W. Knoebel et al Feb. 4, 1963 75 p 46 refs

(Contract DA-36-039-SC-85122)

This report includes information on the following: the electric vacuum gyroscope; surface and atomic physics; computers; system theory; Plato system; vacuum instrumentation; plasma physics; high magnetic field superconductors; vacuum electrical breakdown; and physical electronics. J.R.C.

N63-13356 Radio Technical Commission for Aeronautics, Washington, D.C.

MINUTES OF FALL 1962 ASSEMBLY MEETING, MARRIOTT MOTOR HOTEL AND THE NAVAL RESEARCH LABORATORY, WASHINGTON, D.C., NOVEMBER 27-29, 1962

Dec. 5, 1962 154 p

(Paper 165-62/AS-237)

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9. THE GROUND ENVIRONMENT OF AN INTERNATIONAL DATA LINK SYSTEM J. Z. Millar (Western Union Telegraph Co.) 6 p (See N63-13365 08-08)
10. AIRBORNE ELECTRONIC CONCEPTS E. B. Moore (Aircraft Radio Corp.) 5 p (See N63-13366 08-08)
11. MICROVISION—AN ALL-WEATHER LANDING AID C. C. Bath (Bendix Radio Div.) 9 p (See N63-13367 08-04)
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13. DERIVATION AND INSTRUMENTATION OF GROUND SPEED INFORMATION FROM DME A. R. Applegarth (Natl. Aeronautical Corp.) 2 p (See N63-13369 08-15)
14. A NEW APPROACH TO AVIATION ELECTRONIC SYSTEM PACKAGING W. E. Hanneman (Wilcox Electric Co., Inc.) 5 p (See N63-13370 08-34)

N63-13357 Federal Aviation Agency, Washington, D.C.

THE NATIONAL AIRSPACE UTILIZATION SYSTEM—OPERATIONAL CONCEPTS AND SYSTEM DESIGN

R. J. Shank *In* Radio Technical Commission for Aeronautics, Wash., D.C. Minutes of Fall 1962 Assembly Meeting, Marriott Motor Hotel and the Naval Research Lab., Wash., D.C., Nov. 27-29, 1962 Dec. 5, 1962 16 p (See N63-13356 08-01)

(Paper 169-62/AS-241)

Operational concepts and system design of the national airspace utilization system are discussed. Emphasis is placed on a discussion of the airfield, navigation aids, weather reporting, communications, and air traffic control. B.J.C.

N63-13358 Air Transport Assn. of America, Washington, D.C.

AIR CARRIER VIEWS ON THE NATIONAL AIRSPACE UTILIZATION SYSTEM

Walter A. Jensen *In* Radio Technical Commission for Aeronautics, Wash., D.C. Minutes of Fall 1962 Assembly Meeting, Marriott Motor Hotel and the Naval Research Lab., Wash., D.C., Nov. 27-29, 1962 Dec. 5, 1962 6 p (See N63-13356 08-01)

(Paper 170-62/AS-242)

Air Traffic Control (ATC) must provide greater collision protection and less air traffic delays in the future if the proposed national airspace utilization system is to operate at a reasonable cost. Safety and air-traffic delay problems are discussed. B.J.C.

N63-13359 Aircraft Owners and Pilots Assn., Bethesda, Md.

GENERAL AVIATION AND THE NATIONAL AIRSPACE UTILIZATION SYSTEM

J. B. Hartranft, Jr. *In* Radio Technical Commission for Aeronautics, Wash., D.C. Minutes of Fall 1962 Assembly Meeting, Marriott Motor Hotel and the Naval Research Lab., Wash., D.C., Nov. 27-29, 1962 Dec. 1962 3 p (See N63-13356 08-01)

(Paper 171-62/AS-243)

The views of the general aviation user on the operational concepts and system design of the national airspace utilization system are discussed. The viewpoint is expressed that it would be physically and economically impossible to convert the general aviation system overnight to a new system that would require entirely different equipment in the air and on the ground. B.J.C.

N63-13360 Air Force, Washington, D.C.
THE NATIONAL AIRSPACE UTILIZATION SYSTEM. DOD VIEWS ON THE FAA SYSTEM DESIGN
Frederick K. Nichols *In* Radio Technical Commission for Aeronautics, Wash., D.C. Minutes of Fall 1962 Assembly Meeting, Marriott Motor Hotel and the Naval Research Lab., Wash., D.C., Nov. 27-29, 1962 Dec. 5, 1962 5 p (See N63-13356 08-01)
(Paper 172-62/AS-244)

The Department of Defense views of the system design planning for the national airspace utilization system are given. The DOD feels that to fulfill national defense requirements, using the system being proposed, the following should be provided: (1) Tactical, military flying training in peacetime should be done in an airspace environment that is realistic in comparison to the expected wartime operational situation. (2) An interrelated DOD and FAA system is needed that could be converted from a peacetime status to wartime posture with a minimum of change and a minimum of disruption. (3) An effective system is needed to control both military and civilian aircraft in a military emergency or in a post-strike reconstitution phase. B.J.C.

N63-13373 Batelle Memorial Inst., Columbus, Ohio
PROGRESS RELATING TO CIVILIAN APPLICATIONS DURING DECEMBER, 1962
Russell W. Dayton and Ronald F. Dickerson Jan. 1, 1963 82 p 2 refs
(Contract W-7405-eng-92)
(BMI-1607(Del.)) OTS: $2.00

Reports relating to civilian applications are presented on the following: reactor materials and components; studies of fuels; studies of PuN and its alloys; general fuel-element development; radioisotope and radiation applications; development of a tracer system for in-place filter evaluation; materials development and evaluation; coated-particle fuel materials; corrosion studies of the fluoride-volatility process; progress on USAEC/AECL cooperative program; fission-product deposition studies; radiation-effects study of candidate fuel materials for the MGGR; irradiation of materials and components; gas-cooled reactor program; process development and evaluation of properties of F-48 niobium alloy; and joining of regenerative cell components. R.C.M.

N63-13485 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
SPACE PROGRAMS SUMMARY NO. 37-18, VOLUME IV FOR THE PERIOD OCTOBER 1, 1962 TO DECEMBER 1, 1962. SUPPORTING RESEARCH AND ADVANCED DEVELOPMENT
W. H. Pickering Dec. 31, 1962 212 p refs
(NASA Contract NAS7-100)
(JPL-SPS-37-18, Vol. IV) OTS: $14.50 ph, $6.56 mf

This summary covers systems analysis, program engineering, space instruments development, space instrument systems, lunar and planetary studies, chemistry research, fluid physics, physics, flight computers and sequencers, spacecraft secondary power, guidance and control research, materials research, structures and dynamics, fluid mechanics and thermodynamics, aerothermodynamics, aerodynamic facilities, polymer research, propulsion research, liquid propulsion, communications systems research, communications elements research, and communications systems development. B.J.C.

N63-13542 National Aeronautics and Space Administration, Washington, D.C.
THE SOCIAL AND MORAL RESPONSIBILITIES OF SCIENTISTS AND ENGINEERS
Hugh L. Dryden 1963 8 p Talk before the Cleveland-Akron Sections of the IAS and the ARS (now combined in the AIAA), and of the ASME, Cleveland, Feb. 14, 1963
OTS: $1.10 ph, $0.80 mf

Scientific knowledge is power and as such can be used for good or evil, according to Hugh L. Dryden of NASA. Misuse of the products of science, such as when these products are used for human destruction, is not checked by intellectual achievement. Scientists must practice intellectual honesty, objectivity, and the highest of moral aspirations and ideals so as to be able to guide the leaders of society into using the products of science for the welfare of the nation and all mankind. A.R.B.

N63-13607 Naval Research Lab., Washington, D.C.
REPORT OF NRL PROGRESS
Feb. 1963 34 p 9 refs
OTS: $1.25

CONTENTS:
1. AIRBORNE RADIOACTIVITY FROM NUCLEAR TESTS, 1958–1962 L. B. Lockhart, Jr. p 1-4 2 refs (See N63-13608 08-23)
2. THE U.S. NAVAL RESEARCH LABORATORY'S TRANSDUCER MEASUREMENT PLATFORM ON SENECA LAKE H. L. Saxton and H. E. Eney p 5-11 (See N63-13609 08-15)

N63-13635 National Aeronautics and Space Administration, Washington, D. C.
SEVENTH SEMIANNUAL REPORT TO CONGRESS, JANUARY 1 THROUGH JUNE 30, 1962
James E. Webb [Feb. 8, 1963] 158 p
GPO: $0.75

The activities and accomplishments of NASA are reported as follows: Large launch vehicle and manned spacecraft development; launch vehicles now in use; scientific investigations in space; satellite applications; propulsion and power generation research and development; tracking networks; aeronautics and space research; life science programs; international programs; and management, procurement, support, and services. R.C.M.

N63-13691 National Aeronautics and Space Council, Washington, D.C.
REPORT TO THE CONGRESS FROM THE PRESIDENT OF THE UNITED STATES: UNITED STATES AERONAUTICS AND SPACE ACTIVITIES, 1962
Jan. 28, 1962 132 p

Contributions of the various departments and agencies of the U.S. Government to the national space program during 1962 are summarized. B.J.C.

N63-13693 Atomic Energy Commission. Div. of Reactor Development, Washington, D.C.
NUCLEAR FUELS AND MATERIALS DEVELOPMENT
Sept. 1962 462 p 6 refs
(TID-11295 (2nd ed.)) OTS: $5.50

This report on nuclear fuels and materials development covers the following: fuel and fertile materials; cladding and structural materials; control rod materials; moderator materials; fabrication technology; physical and mechanical properties; and nondestructive testing. J.R.C.

N63-13696 Naval Ordnance Lab. Explosions Research Dept., White Oak, Md.
GUIDED MISSILE PROPULSION SYSTEM. HAZARDS OF ELECTROMAGNETIC RADIATION TO ORDNANCE (HERO). RF CHARACTERISTICS OF ELECTRO-EXPLOSIVE DEVICES Quarterly Progress Report, Period Covered: April 1-June 30, 1962
[1962] 17 p 1 ref

The significance of the M-parameter, procedure for step-function testing, instrumentation for automated step-function testing, data for sorting of electro-explosive devices, constant current firing of Mk 1 Squibs, and carbon primers are discussed. R.C.M.

N63-13736 General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.
SODIUM-COOLED REACTORS PROGRAM. FAST CERAMIC REACTOR DEVELOPMENT PROGRAM Fourth Quarterly Report, July-September 1962
F. J. Leitz, ed. AEC Div. of Tech. Inform., Jan. 31, 1963 92 p 14 refs
(Contract AT(04-3)-189)
(GEAP-4080) OTS: $2.00

This Fast Ceramic Reactor Development Program is directed toward the development of fast reactors employing ceramic fuels, with emphasis on mixed plutonium-uranium oxide. The following work was covered: vented fuel development; fuel testing in Treat (transient reactor test facility); fuel fabrication development; and reactor dynamics and design. J.R.C.

N63-13737 Northwestern Technological Inst., Evanston, Ill.
MANAGEMENT SCIENCE AND MANAGING
A. Charnes and W. W. Cooper Mar. 1962 27 p 23 refs
(Contracts Nonr-1228(10) and Nonr-760(01))
(ONR Res. Memo-53)

The history of management is reviewed to point out the current status of management science and some of the possible future developments in management. The areas covered include: contribution to management by military leaders; management engineering; management concepts of Charles Babbage; current developments in methodology; and social and managerial implications for the future. R.C.M.

N63-13744 National Aeronautics and Space Administration, Washington, D.C.
A WORLD IN SPACE
Homer E. Newell Washington, NASA Office of Educational Programs and Service, Feb. 1963 20 p
(NASA AL-B-2-63) GPO: $0.15

The following areas of space exploration are discussed: geophysics, astronomy, cosmology, extraterrestrial life, manned space flight, space engineering, space environment, measurement of space phenomena, and space phenomena on earth. R.C.M.

N63-13758 Centre National d'Etudes Spatiales, Paris (France)
RAPPORT D'ACTIVITÉ [PROGRESS REPORT] Mar. 1, 1962-Sept. 1, 1962
Feb. 1963 68 p In French

This report of the National Center for Space Studies outlines the organizational structure of the Center and the progress it has made to date. Progress in the following areas is discussed: sounding rockets, Diamant satellite, instrumentation, radar, launching sites, and satellite tracking. C.L.R.

N63-13582 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
SPACE PROGRAMS SUMMARY NO. 37-19, VOLUME IV FOR THE PERIOD DECEMBER 1, 1962 TO JANUARY 31, 1963. SUPPORTING RESEARCH AND ADVANCED DEVELOPMENT
W. H. Pickering Feb. 28, 1963 214 p
(NASA Contract NAS7-100)
(JPL-SPS-37-19, Vol. IV) OTS: $14.50 ph, $6.62 mf

This summary covers systems analysis, space instruments development, space instrument systems, chemistry, fluid physics, physics, spacecraft secondary power, guidance and control research, structures and dynamics, field mechanics and thermodynamics, aerodynamic facilities, environmental facilities, polymer research, propulsion research, and advanced propulsion engineering, communications systems research, communications elements research, and radio development. B.J.C.

02 AERODYNAMICS OF BODIES, COMBINATIONS, AND INTERNAL FLOW

Includes: aerodynamics of channels, cowls, ducts, ejectors, nozzles, etc.

For related information see: 03 Aerodynamics of Wings, Rotors and Control Surfaces; and 11 Fluid Mechanics.

N63-13447 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
RESONANCE TUBES IN A SUPERSONIC FLOW FIELD
T. Vrebalovich July 30, 1962 58 p 16 refs
(NASA Contract NAS7-100)
(JPL-TR-32-378) OTS: $5.60 ph, $1.94 mf

Several configurations of resonance tubes were tested in a supersonic wind tunnel to determine the cause of the oscillations and the higher-than-tunnel stagnation temperatures present in the tubes. These tubes were instrumented with pressure transducers, thermocouples, hot wires, and a foreign gas injector. Flow processes in and near the tubes were determined from spark schlieren photographs of a glass-sided model. Heat rates were determined from transient temperature measurements. A cyclic process is proposed, and comparisons between the measured and theoretical predictions are made. Author

N63-13452 General Applied Science Labs., Inc., Westbury, N. Y.
THE CALCULATIONS OF THE FLOW FIELD ABOUT A BLUNTED 9° CONE Final Report, Section I
E. Kennedy, A. Fields, and M. Seidman Sept. 18, 1962 71 p 7 refs Prepared for Lincoln Lab., MIT
(Contract AF 19(604)-7400; ARPA Order 13)
(GASL Tech. Rept. 256; LL-37-13)

The inviscid flow fields about a hemispherically blunted cone (9° half-angle) have been calculated at five hypersonic Mach numbers. The calculation is begun in the subsonic region by the method of Vaglio-Laurin and Ferri and extended into the near-wake by the method of characteristics. The air was assumed to be a mixture of perfect gases, either chemically frozen or in thermodynamic equilibrium. Results from these calculations were used as initial data for rate and wake calculations presented in this report. Author

N63-13453 General Applied Science Labs., Inc., Westbury, N.Y.
THE CALCULATION OF THE FLOW FIELD ABOUT A BLUNTED 9° CONE Section II, Final Report
M. H. Bloom and E. K. Kennedy Sept. 18, 1962 48 p 7 refs Prepared for MIT Lincoln Lab.
(Contract AF 19(604)-7400; ARPA Order 13)
(GASL-TR-256; LL-37-14; LL-37-15)

Calculations are made of the flow field about a blunted 9° cone. The tabulated results of the calculations in each case, at 10 representative stations along each wake, are given. The data given show

radial distributions of velocity, state, and species, as well as wake thickness, at each station. The profiles are shown plotted at the initial station and at one typical downstream station for each case. Also plotted are the distributions of variables along the axis of flow.

J.R.C.

N63-13477 General Applied Science Labs., Inc., Westbury, N.Y.

THE NUMERICAL CALCULATION OF THE FLOW FIELD AROUND A REENTRY BODY

E. Kennedy and A. Fields Sept. 18, 1962 49 p 4 refs Prepared for Lincoln Lab., MIT

(Contract AF 19(604)-7400)

(GASL-TR-231; LL-37-10)

The flow field around the Trailblazer I body (a sphere with a short cylindrical afterbody) is calculated for three flight conditions—18,900 fps at 150,000 ft, 20,000 fps at 200,000 ft, and 20,400 fps at 250,000 ft. In the calculations, the flow field around the reentry body is assumed to have a frozen chemical composition (N_2, N, O_2, O, and NO) along the streamlines. The effect of additional shocks in the flow field is calculated. These shocks lead to order-of-magnitude changes in electron density in the near wake. In the far wake, the discontinuities due to these shocks disappear, and the various parameters vary monotonically from body to shock. B.J.C.

N63-13508 Advisory Group for Aeronautical Research and Development, Paris (France)

A REVIEW OF MEASUREMENTS ON AGARD CALIBRATION MODELS

R. Hills, ed. (Aircraft Research Assoc., Gt. Brit.) Nov. 1961 243 p 112 refs

(AGARDograph-64)

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6. PART VI. TESTS ON AGARD MODEL E R. Hills (Aircraft Research Assoc., Gt. Brit.) p 229-245 18 refs (See N63-13514 08-02)

N63-13509 Aircraft Research Assn., Ltd., Bedford (Gt. Brit.)

PART I. TESTS ON AGARD MODEL A

R. Hills *In* Advisory Group for Aeronautical Research and Development, Paris (France) A Review of Measurements on AGARD Calibration Models Nov. 1961 p 7-34 27 refs (See N63-13508 08-02)

Agard Model A was tested in a number of wind tunnels and in flight before it was selected as an Agard calibration model for testing and checking supersonic wind tunnels. Most of the tunnel tests were made on the model without fins, and a single flight test was also made on a sting-supported model without fins. Results of these tests are summarized. The tests were made over a range of Reynolds numbers from 1×10^6 to 40×10^9 in tunnels and 12×10^6 to 140×10^6 for free-flight models. Mach numbers covered ranges from 1.5 to 6.9 in tunnels and 0.85 to 4 in flight. Measurements were made on base pressure drag, forebody drag, forebody pressure drag, skin-friction, drag with and without fins, and lift and pitching moment. A.R.B.

N63-13510 National Aero- and Astronautical Research Inst., Amsterdam (Netherlands)

PART II. A REVIEW OF MEASUREMENTS ON AGARD CALIBRATION MODEL B IN THE TRANSONIC SPEED RANGE

H. Valk and J. H. van der Zwaan *In* Advisory Group for Aeronautical Research and Development, Paris (France) A Review of Measurements on AGARD Calibration Models Nov. 1961 p 35-94 15 refs (See N63-13508 08-02)

A survey and a comparison are presented of the results from tests with AGARD Calibration Model B at Mach numbers between 0.7 and 1.3. The available data include tests in different wind tunnels, at different Reynolds numbers and blockage percentages for models with and without fixed transition. The results from different sources show many discrepancies. A first effort is made to establish reference curves, to facilitate further comparison. Author

N63-13511 National Aero- and Astronautical Research Inst., Amsterdam (Netherlands)

PART III. A REVIEW OF MEASUREMENTS ON AGARD CALIBRATION MODEL B IN THE MACH NUMBER RANGE FROM 1.4 TO 8

J. P. Hartzuiker *In* Advisory Group for Aeronautical Research and Development, Paris (France) A Review of Measurements on AGARD Calibration Models Nov. 1961 p 95-136 33 refs (See N63-13508 08-02)

This report contains a survey and a comparison of the results from tests with AGARD Calibration Model B at Mach numbers between 1.4 and 8. The data include tests from various wind tunnels and in free flight, for a range of Reynolds numbers between 10^6 and 98×10^6. Models with and without fixed transition of the boundary layer have been considered. Good agreement between the various measurements of the lift, the pitching moment, and the neutral point location has been found. With respect to drag, many differences exist. Author

N63-13512 National Aero- and Astronautical Research Inst., Amsterdam (Netherlands)

PART IV. A REVIEW OF MEASUREMENTS ON AGARD CALIBRATION MODEL C IN THE TRANSONIC SPEED RANGE

H. Valk *In* Advisory Group for Aeronautical Research and Development, Paris (France) A Review of Measurements on AGARD Calibration Models Nov. 1961 p 137-211 14 refs (See N63-13508 08-02)

This report contains a survey and a comparison of the results from tests with AGARD Calibration Model C at Mach numbers between 0.7 and 1.3. The available data include tests in different wind tunnels, at different Reynolds numbers on blockage percentages, on models with and without fixed transition of the boundary layer. The correspondence between the results of the various tests is not very satisfactory. There are many differences and the pitching moment, especially, shows large discrepancies in value and in trend. Some indications are given of the probable origins of the discrepancies. Author

N63-13513 Aircraft Research Assn., Ltd., Bedford (Gt. Brit.)

PART V. TESTS ON AGARD MODEL D

R. Hills *In* Advisory Group for Aeronautical Research and Development, Paris (France) A Review of Measurements on AGARD Calibration Models Nov. 1961 p 213-227 5 refs (See N63-13508 08-02)

Measurements of damping derivatives made in four different low-speed tunnels on an unswept tapered wing are compared. All the tunnels used a forced-oscillation technique, but had different methods of taking the measurements. The results show reasonable agreement, though there is a considerable scatter in any one set of measurements. Author

N63-13514 Aircraft Research Assn., Ltd., Bedford (Gt. Brit.)
PART VI. TESTS ON AGARD MODEL E
R. Hills *In* Advisory Group for Aeronautical Research and Development, Paris (France) A Review of Measurements on AGARD Calibration Models Nov. 1961 p 229-245 18 refs (See N63-13508 08-02)

Tests on hemispheres in various hypersonic facilities are summarized. Pressure distribution and heat-transfer measurements are in reasonable agreement over the forebody, though there are some discrepancies in results over the afterbody. A few measurements of shock wave detachment distance are also compared with theoretical curves. Author

N63-13562 National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
AERODYNAMIC CHARACTERISTICS AT A MACH NUMBER OF 6.77 OF A 9° CONE CONFIGURATION, WITH AND WITHOUT SPHERICAL AFTERBODIES, AT ANGLES OF ATTACK UP TO 180° WITH VARIOUS DEGREES OF NOSE BLUNTING
Luther Neal, Jr. Washington, NASA, Mar. 1963 25 p 19 refs (NASA TN D-1606) OTS: $0.75

Force and moment tests have been conducted on both sharp and spherical blunted cone configurations having semivertex angles of 9° in the Langley 11-inch hypersonic tunnel at a Mach number of 6.77, a Reynolds number per inch of 135,000, and an angle-of-attack range from 0° to 180°. Analysis of the results indicates that a second stable trim condition can exist near $\alpha = 180°$ for flat-base cone configurations depending upon the fineness ratio of the cone. However, it appears that this condition may be prevented by the addition to the basic cones of spherical afterbody caps whose centers of curvature coincide with the respective moment references. A comparison of the experimental data with theory by using a combination of impact and modified Newtonian theory over different portions of the body shows that, except for the stable region at an angle of attack of 180° for the blunt cones, the method provides an adequate means of predicting the general trends of cone configurations throughout the entire 180° angle-of-attack range. Moreover, the actual magnitudes of the characteristics are predicted satisfactorily in many instances. At an angle of attack of 0°, however, the method significantly overpredicts the lift-curve slope C_{L_α} and the negative pitching-moment-curve slope C_{m_α} for the cones with large nose bluntness. Author

N63-13716 National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
AERODYNAMIC DRAG AND STABILITY CHARACTERISTICS OF TOWED INFLATABLE DECELERATORS AT SUPERSONIC SPEEDS
John T. Mc Shera, Jr. Washington, NASA, Mar. 1963 24 p 6 refs (NASA TN D-1601) OTS: $0.75

A wind-tunnel investigation has been conducted to study the possibility of inflating balloon and cone devices to give the same drag and stability characteristics as their solid counterparts over the Mach number range from 2.00 to 4.65. The results include some effects of Mach number, tow-cable length, and inlet configurations on the drag and stability of these inflatable decelerators. Both the closed pressure-inflatable and self-inflatable (ram-air) decelerator configurations were fully inflated and had approximately the same drag and stability as their solid counterparts. The decelerator exhibits excellent stability in the supersonic wake region. The drag reaches a maximum and has little change with increases in tow-cable length when the decelerator reaches the supersonic wake region. Author

N63-13718 National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EFFECT OF CROSS-SECTION SHAPE ON THE AERODYNAMIC CHARACTERISTICS OF BODIES AT MACH NUMBERS FROM 2.50 TO 4.63
Dennis E. Fuller, David S. Shaw, and Donald L. Wassum Washington, NASA, Mar. 1963 31 p 5 refs (NASA TN D-1620) OTS: $0.75

An investigation has been made in the high-Mach-number test section of the Langley Unitary Plan wind tunnel to determine the aerodynamic characteristics of several bodies that differed only in cross section. All of the bodies had a fineness ratio of 10 and the same longitudinal cross-sectional area distribution. The cross-sectional shapes tested were a circle; ellipses with width-height ratios of ½:1, 1½:1, and 2:1; and flat-bottom and flat-top semiellipses. In addition, flat-bottom and flat-top bodies with triangular-shaped cross sections and rounded corners were tested. The tests were performed at Mach numbers from 2.50 to 4.63, and at Reynolds number per foot of 2.5×10^6. The results indicate that increasing the width-height ratio of the bodies provides substantial increases in lift and in lift-drag ratio. In addition, the results for the flat-top body with an unsymmetrical nose indicates the possibility of combining positive pitching moments at zero angle-of-attack with high lift-drag ratios. Author

03 AERODYNAMICS OF WINGS, ROTORS, AND CONTROL SURFACES

Includes: ailerons; airfoil sections; cascades; fans; flaps; propellers; rotors; slats; spoilers; etc.

For related information see: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; and 11 Fluid Mechanics.

N63-13494 Southampton U. (Gt. Brit.)
A THEORETICAL AND EXPERIMENTAL STUDY OF OSCILLATING WEDGE SHAPED AEROFOILS IN HYPERSONIC FLOW
R. A. East Nov. 1962 62 p 18 refs (AASU-228)

Aerodynamic stiffness and damping derivatives have been measured in a hypersonic-gun wind tunnel for sharp and blunt-nosed two-dimensional, single wedge shapes oscillating in the pitching mode in hypersonic flow. The results, which have been compared with theoretical prediction, modified to account for leading-edge bluntness, show that this may increase the damping by up to 50% for certain axis positions. Details of the experimental technique, designed to measure the derivatives in the short running times available, are described. Author

N63-13516 National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
OFF-DESIGN AERODYNAMIC CHARACTERISTICS AT MACH NUMBERS 1.61 AND 2.20 OF A SERIES OF HIGHLY SWEPT ARROW WINGS DESIGNED FOR MACH NUMBER 2.0 EMPLOYING VARIOUS DEGREES OF TWIST AND CAMBER
Wilbur D. Middleton and Russell B. Sorrells Washington, NASA, Mar. 1963 20 p 3 refs (NASA TN D-1630) OTS: $0.50

A series of five highly swept arrow wings were tested to investigate their respective off-design performance. Aerodynamic characteristics of the family of wings, designed for Mach number 2.0, employing design lift coefficients of 0, 0.08, and 0.16, were measured

at Mach numbers of 1.61 and 2.20 and a Reynolds number, based on the mean aerodynamic chord, of 4.4×10^6. A 70° swept arrow wing-of-aspect ratio 2.24 with moderate twist and camber (design lift coefficient of 0.08), which had produced the highest lift-drag ratio during design Mach number 2.0 tests, likewise produced the highest lift-drag ratios during the off-design tests. This wing gave maximum lift-drag ratios of 9.2, 8.8, and 8.4 at Mach numbers of 1.61, 2.05, and 2.20, respectively, compared with maximum lift-drag ratios of 8.1, 8.1, and 7.8 for the corresponding flat wing over the same Mach number range. Two twisted and cambered wings (of 70° and 75° leading-edge sweep) designed for a lift coefficient of 0.16 exhibited relatively minor superiority in lift-drag ratios over the flat wings throughout the Mach number range, and became approximately equal in maximum lift-drag ratio to the flat wings at a Mach number of 2.20. Author

N63-13541 Aeronautical Research Council (Gt. Brit.)

THE CALCULATED EFFECT OF THE STATION OF MAXIMUM CROSS-SECTIONAL AREA ON THE WAVE DRAG OF DELTA WINGS

J. H. B. Smith and W. Thomson London, HMSO, 1962 29 p 4 refs

(ARC-CP-606; previously issued as RAE-TN-AERO-2782, ARC-23112) Available from HMSO: 4s. 6d.

Use is made of previously calculated properties of a family of delta wings, with subsonic leading edges and diamond cross sections, to investigate the effects on the drag and pressure distribution due to volume of variations in the streamwise station at which the cross-sectional area is a maximum. For each station of the maximum cross-sectional area and each value of the aerodynamic slenderness ratio, Bs/l, the wing of the family which has least drag for given length and volume is found. As the station of maximum cross-sectional area is moved aft from 65% of the length from the apex, the drag of this optimum wing rises; the rise being steeper for lower values of Bs/l. In parallel, adverse pressure gradients and the suction on the wing near the trailing edge both increase so that it becomes less likely that the calculated values will be reproduced in a real flow. Author

N63-13702 Royal Aircraft Establishment, Farnborough (Gt. Brit.)

RESEARCH RECENTLY CARRIED OUT BY THE BELL HELICOPTER COMPANY (RECHERCHES RECEMMENT MENEES PAR LA BELL HELICOPTER COMPANY)

B. Kelley London, Ministry of Aviation, Dec. 1962 8 p Transl. by A. E. Clarke from Tech. Sci. Aéronaut. Spatiales (Paris), no. 2, 1962 p 121-125

(RAE Library Translation-1020)

The mechanical stability of rigid rotor systems is considered. It is shown that when the mass of the system is not concentrated at the axis of rotation, two natural frequencies exist due to gyroscopic effects. Severe difficulty has been encountered with a two-bladed rigid rotor because of marked gyroscopic asymmetry in this case. Reference is made to semirigid systems, including spring restrained flapping rotors. With the latter, mechanical instability does not become serious, even on a two-bladed configuration, until the spring restraint is large. Author

N63-13707 Royal Aeronautical Society. Transonic Aerodynamics Committee, London (Gt. Brit.)

METHOD FOR THE RAPID ESTIMATION OF THEORETICAL SPANWISE LOADING DUE TO A CHANGE OF INCIDENCE

A. B. Haines (Aircraft Res. Assoc.) et al Aug. 1962 14 p 7 refs

(Transonic Data Memo. 6208)

A method is presented for the rapid estimation of the spanwise load distribution over uncambered and untwisted wings in unseparated subcritical flow. It covers a wide range of planforms and provides for curved leading edges and cranked trailing edges. The first step in the method evaluates the spanwise center of pressure and may be useful in its own right. When coupled with a corresponding method for local aerodynamic center, the procedure may be an adequate substitute for calculations by lifting-surface theory to obtain the incremental loading due to change of lift coefficient. Therefore, it may also be useful as a preliminary step in the application of the Weber method of calculating the chordwise pressure distribution on thick swept wings. Author

N63-13724 Royal Aircraft Establishment, Farnborough (Gt. Brit.)

THE AERODYNAMIC CHARACTERISTICS OF A LOADED HELICOPTER ROTOR FROM A THREE-DIMENSIONAL VORTEX SYSTEM (AERODINAMICHESKIE KHARAKTERERISTIKI NESUSHCHEGO VINTA VERTOLETA S PROSTRANSTVENNOY VIKHREVOY SISTEMOY)

Van Shi-Tsun London, Ministry of Aviation, Nov. 1962 17 p 3 refs Transl. from Aviatsionnaya Tekhnika (USSR), no. 1, 1961 p 3-12 (RAE Library Translation 1013)

A method based on the theory of a plane vortex system is used for the calculation of the aerodynamic characteristics of a helicopter. This does not, however, include the regimes of helicopter flight with small horizontal velocities and large angles-of-attack. An attempt is made at creating a more general method which defines the aerodynamic characteristics of a helicopter in all flight regimes. Author

N63-13756 National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

AN ANALYSIS OF THE DELTA-WING HYPERSONIC STABILITY AND CONTROL BEHAVIOR AT ANGLES OF ATTACK BETWEEN 30° AND 90°

David E. Fetterman and Luther Neal, Jr. Washington, NASA, Mar. 1963 59 p 25 refs

(NASA TN D-1602) OTS: $1.50

An experimental investigation has been conducted to determine the force, stability, and control characteristics of a 70°-sweep delta wing at a Mach number of 6.83. Nose incidence (provided by a forward panel 16 percent of the wing area) and a trailing-edge flap (36-percent wing area) were used as the trim devices. The results were obtained by integrating extensive pressure measurements over the windward surface of the wing and thereby making possible a determination of not only the total forces and moments produced but also contributions of the local nose, middle, and flap components, which facilitated a dependable analysis of the various behavior encountered. The scope of measurements included angles-of-attack between 30° and 90°, nose incidence values of 0°, 10°, and 20°, and flap deflections from 10° to -90°, at a Reynolds number of 0.60×10^6. The delta wing with undeflected nose panel was found to be stable and controllable with trailing-edge flaps at all angles-of-attack except in the region of $C_{L,max}$ where instability at trim resulted from overexpansion phenomenon over the trailing-edge flap. Nose incidence, fortunately, tends to overcome this instability at trim without significant effect on $C_{L,max}$. Extrapolations of the results to smaller flap areas indicated that the effects of varying flap area on trim stability, or instability, are small, except at extreme angles-of-attack, but with nose incidence of about 10°, trim stability and control can be achieved through an angle-of-attack of 90° with flap areas of about 15-percent wing area. A simple, semiempirical theory suitable for preliminary design purposes effectively predicts the force characteristics in an out of trim and, by extending the method to account for flap overexpansion effects, the unstable trim regions near $C_{L,max}$ and the curative effects of nose incidence can also be predicted. Author

04 AIRCRAFT

Includes: specific types of complete aircraft (e.g., Ground Effects Machines, Flexible Wings, STOL, and VTOL); flight tests; operating problems; stability and control.

For related information see: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; 03 Aerodynamics of Wings, Rotors, and Control Surfaces; and 30 Space Vehicles.

N63-13367 Bendix Corp. Bendix Radio Div., Baltimore, Md.

MICROVISION—AN ALL-WEATHER LANDING AID

Carl C. Bath *In* Radio Technical Commission for Aeronautics, Wash., D.C. Minutes of Fall 1962 Assembly Meeting, Marriott Motor Hotel and the Naval Research Lab., Wash., D.C., Nov. 27-29, 1962 Dec. 5, 1962 9 p (See N63-13356 08-01)
(Paper 179-62/AS-251)

Microvision, a monitoring system for use in an all-weather landing system, is discussed. Microvision presents to the pilot a picture of the landing strip just as it would appear to him in a routine clear-weather night landing. The system depicts runway boundaries on its cockpit display. A true perspective view of runway position is given with respect to the aircraft's alignment in roll, pitch, and yaw. There is a time delay of only a few microseconds between measurement and display. B.J.C.

N63-13411 Army Missile Command. Guidance and Control Lab., Redstone Arsenal, Ala.

DEVELOPMENT OF THE ELECTRICAL AND FIRE CONTROL SYSTEMS OF THE XM-3, 2.75-INCH AREA ROCKET WEAPON SYSTEM FOR THE UH-1B HELICOPTER

Charles W. Wingfield Feb. 15, 1963 14 p 8 refs
(RG-TR-62-6)

A discussion is presented of development work performed to provide a moving line-of-sight, movable multirocket launcher firing-control system for the UH-1B helicopter fire weapon system. Discussion is confined to the electrical and fire-control systems. Concept, missions, and test results are discussed. The report includes work from project inception through completion of developmental tests. Author

N63-13412 Army Missile Command. Structures and Mechanics Lab., Redstone Arsenal, Ala.

REDESIGN OF LITTLEJOHN FRONT SHOE FOR MATERIALS COMPATIBILITY

E. R. Parker, J. H. Honeycutt, and W. T. Mc Clane Dec. 28, 1962 33 p
(RS-TR-62-9)

Flight tests of Littlejohn missiles have revealed several instances of front-shoe malfunction. The shoe was redesigned, first by a change in materials and finishes to suppress corrosion and second by a redesign of the working parts to eliminate a suspected binding moment. The second redesign also incorporated the materials and finishes changes. Salt-spray tests of 348 hours' duration were conducted on several shoes of each design, including the current design as a control, in order to evaluate the changes. Shoes of the basic design indicated malfunction after exposure. Although materials and finishes changes in the basic design resulted in improved performance, the redesigned shoe, eliminating a binding moment, and incorporating materials and finishes changes, was shown to be superior. The force required to pull the release pin from each shoe was obtained before and after the test. In every instance the force required to remove the pin, after exposure, was considered too great to expect hand removal. Author

N63-13481 Federal Aviation Agency. Systems Research and Development Service, Atlantic City, N.J.

A SIMULATION STUDY OF IFR HELICOPTER OPERATIONS IN THE NEW YORK AREA Final Report

A. L. Sluka, J. R. Bradley, D. W. Yungman, and D. A. Martin June 1962 103 p

The purpose of this study was to test and evaluate air-traffic control procedures, separation standards, facilities, route structures, and services which would be required for helicopter instrument operations in the environmental area of New York. The simulation program was divided into two phases. In Phase I, helicopter route structures 3 and 5 statute miles in widths were designed, based on existing navigational aids. This phase compared two methods, common controller and discrete controller concepts of delegating control responsibility for rotary wing operations. Concurrently, different control procedures were examined by which helicopters were either integrated or segregated from conventional aircraft during instrument approach and landing operations. Phase II studies explored a modified helicopter route structure supplemented with additional aids to navigation. Results indicated that as helicopter operations increased, system efficiency was more readily maintained using the discrete controller concept under segregated conditions. Author

N63-13506 Cornell Aeronautical Lab., Inc., Buffalo, N. Y.

AUTOMATIC CONTROL OF STATIC ELECTRICITY FOR ARMY HELICOPTERS

C. J. Tona Fort Eustis, Va., Army Transportation Research Command, Oct. 1962 90 p 10 refs
(Contract DA-44-177-TC-652)
(TCREC-TR-62-22)

A design for a corona discharge system of equipment to maintain automatically a net charge on a helicopter about the zero level was completed and extensive operational tests conducted. An electrostatic field sensor was used to measure the incident field due to the electrostatic charge on the aircraft. An error signal, proportional to the difference between the charge existing on the aircraft and a chosen reference level, was used to control operational sequence of a high-voltage power supply convected to a corona discharge point. The removal of charge from the aircraft in the form of a discharge current is done in such a manner as to minimize the error within a closed-loop system. System equipment was installed in an H-37 helicopter and operational tests conducted in a hot-day environment. The aircraft charge was maintained automatically within predetermined limits, corresponding to a net remaining charge voltage of approximately 300 volts with respect to ground. Author

N63-13571 National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.

THE RECORD-SETTING RESEARCH AIRPLANES

James A. Martin N.Y., Inst. of the Aerospace Sci., 1962 Repr. from Aerospace Eng., v. 21, no. 12, Dec. 1962 p 49-54 8 refs

The first compilation of all available data on the unofficial records of the rocket airplanes is presented. The maximum Mach number, true velocity, and the altitude obtained by the X-1-1, D-558-11, X-1A, X-2, and X-15 airplanes are given in tabular form. Also, the physical characteristics of these airplanes are given and include wing span, wing sweep, launch weight, and landing weight. J.R.C.

N63-13660 Advisory Group for Aeronautical Research and Development, Paris (France)

RECOMMENDATIONS FOR V/STOL HANDLING QUALITIES

A. Botrel, D. G. Gould, D. Lean, J. Reeder, and J. M. H. Van Vlaenderen Oct. 1962 41 p 3 refs
(AGARD-408)

Recommendations are presented on desirable handling qualities for military V/STOL aircraft. These recommendations, which are tentative, particularly as to their application to large aircraft, are based

in some respects on requirements for U.S. military helicopters, but considerable use has been made of the results of flight assessments of handling qualities of a number of V/STOL research aircraft. Author

N63-13692 National Aero- and Astronautical Research Inst., Amsterdam (Netherlands)
SIEBEL PH-NLL, TYPE Si 204 D-1. RESULTS OF FLIGHT TESTS IN SYMMETRICAL GLIDING AND POWERED FLIGHT WITH THE AIRCRAFT EQUIPPED WITH METAL AND FABRIC COVERED ELEVATORS
C. M. Kalkman, comp. Apr. 24, 1962 67 p 6 refs
(NLL-TN-V.1875)

The results of model measurements referring to the longitudinal stability and control of the Siebel aircraft in gliding and powered flight are compared with those of full-scale tests. For this purpose the aircraft was equipped with metal elevators instead of the original fabric-covered ones, in order to eliminate possible deformation effects of the elevator as much as possible. The influence of propeller slipstream on the longitudinal stability and control of the aircraft has been analyzed. The static margins stick-fixed and stick-free have been determined. An attempt has been made to separate the effects of power and angle-of-attack on the longitudinal static stability for the stick-fixed case. Author

N63-13703 David Taylor Model Basin. Aerodynamics Lab., Washington, D.C.
EXPERIMENTAL INVESTIGATION OF THE EFFECTS OF STABILIZING NOZZLE WIDTH ON THE HOVERING STABILITY AND PERFORMANCE OF A CIRCULAR GEM MODEL
Martin D. Fink Feb. 1963 19 p 4 refs
(Rept. 1711; DTMB-AERO-1047)

Hovering stability and performance data are presented for various stabilizing nozzle widths over a range of height parameters and pitch angles. General indications are that stability increases continuously with increasing secondary nozzle width; however, except at very high operating heights, the increase in stability is slight for increases in width beyond half the primary nozzle width. Lifting power requirements increase continuously with increasing width at a constant operating height. Author

N63-13721 National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
NIKE APACHE PERFORMANCE HANDBOOK
Reed B. Jenkins Washington, NASA, Mar. 1963 25 p 5 refs
(NASA TN D-1699) OTS: $0.75

The configurational and mass characteristics of the Nike Apache two-stage solid-propellant sounding rocket system are described. Aerodynamic and performance data on the Nike Apache are presented for the various configurations commonly flown. Calculations of vehicle stability and of velocity, altitude, and range versus time and payload weight are presented graphically for use in determining maximum performance of any given configuration as a function of various parameters. Flight-test data on lateral and longitudinal accelerations during the boost phases are included. Author

05 ASTRONOMY AND ASTROPHYSICS

Includes: celestial mechanics; and radioastronomy.

For related information see: 12 Geophysics; and 29 Space Sciences.

N63-13443 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
PLANET ILLUMINANCE
G. W. Meisenholder Nov. 10, 1962 20 p 1 ref
(NASA Contract NAS7-100)
(JPL-TR-32-361) OTS: $1.60 ph, $0.80 mf

This report summarizes the theoretical value of planet illuminance vs. range and phase angle. Solutions were obtained by digital computer and are based on the assumption of a diffuse (lambert), spherical planet receiving radiation from the sun at the respective planet mean solar distance. Planet albedo is assumed invariant with wavelength and has a value as given in astronomical journals for the visible region. Author

N63-13681 Weizmann Inst. of Science, Rehovoth (Israel)
THE STRENGTH OF THE ν_3 VIBRATION OF H_2O Technical Scientific Note No. 3
W. S. Benedict (Johns Hopkins U.) and J. H. Jaffe Oct. 1962 4 p 7 refs
(Contract AF 61(052)-388)

The optical refraction spectrum of water vapor was measured to determine the band strength (S_ν^o) of the ν_3 vibration. The line strength (S_R^o) was measured with a hollow prism refractometer combined with a grating monochromator of high resolving power. The value for the line strength (4.0 ± 0.6 cm^{-2} atm^{-1} at 300°K) was used to calculate the band strength by the formula $S_\nu^o = S_R^o\, Q_R\, \nu_o / \nu L g \exp(-E''/kT)$ where ν_o is the frequency of the band origin (3756 cm^{-1}), g is the statistical weight (3 for the odd-τ initial state), L the rotational matrix element, (3/2), E" the rotational energy of the initial state (42.37 cm^{-1} for 1_1) and Q_R is the rotational state function (178.8 at 300°K). With these values $S_\nu^o = 192 \pm 28$ cm^{-2} atm^{-1} at 300°K, and the corresponding value of the vibrational transition moment (R_{000}^{001}) is 7.1×10^{-20} e.s.u. R.C.M.

06 AUXILIARY SYSTEMS

Includes: fuel cells and solar cells; gas turbines; hydraulic, pneumatic and electrical control systems and actuators; and inverters.

For primary propulsion systems see: 27 Propulsion

For related information see: 08 Communications; 09 Electronics; 10 Facilities; 15 Instrumentation; and 22 Navigation and Guidance.

N63-13558 Republic Aviation Corp., Farmingdale, N. Y.
HYDRAULIC FLUIDS FOR THE SUPERSONIC TRANSPORT
Charles Spar Dec. 15, 1962 15 p
(RAC-1047; ARD-981-600)

The purpose of this program is to determine the high-temperature hydraulic fluid best suited for application in a supersonic transport. Besides being operational between −40° F and +650° F, this fluid must present a minimum of difficulties in the selection of equipment to operate with it and, if possible, imcorporate a reasonable degree of fire resistance. Author

N63-13742 Atomic Energy Commission. Div. of Technical Information, Washington, D.C.
DIRECT ENERGY CONVERSION AND SYSTEMS FOR NUCLEAR AUXILIARY POWER (SNAP). A LITERATURE SEARCH

Sidney F. Lanier and Henry D. Raleigh, comps. Jan. 1963 66 p 553 refs
(TID-3561(Rev. 3)) OTS: $1.50

A literature search of direct energy conversion and systems for nuclear auxiliary power includes: radioisotope-fueled units; reactor-fueled units; direct energy conversion; and nuclear auxiliary power. I.v.L.

N63-13785 General Dynamics Corp. General Atomic Div., San Diego, Calif.

INVESTIGATIONS OF CARBIDES AS CATHODES FOR THERMIONIC SPACE REACTORS Quarterly Progress Report for the Period ending Nov. 30, 1961

A. F. Weinberg, R. G. Hudson, B. Siefner, and L. Yang [1962] 54 p 7 refs
(NASA Contract NAS5-1253)
(GA-2670) OTS: $5.60 ph, $1.82 mf

The physicochemical properties of mixed carbides of uranium and zirconium are being measured at temperatures up to 2400° K. Vapor-loss measurements were conducted for specimens with nominal compositions of 20 mol-% UC:80 mol-% ZrC and 90 mol-% UC:10 mol-% ZrC at 2300° ±11° K in a vacuum of 4×10^{-9} mm Hg to establish if residual oxide layers were influencing weight-loss measurements. Comparison of the data obtained with measurements performed in vacuums of 1×10^{-5} mm Hg showed that no change was effected by the difference in vacuum. After 95-hr. exposure at 2300° K, the weight loss of the specimen with a nominal composition of 90 mol-% UC:10 mol-% ZrC continued to decrease at a constant rate. Preliminary experiments to determine the influence of a cesium-vapor environment on the weight loss are described. Electrical-resistivity measurements are being conducted for mixed-carbide specimens of differing U:Zr ratios from room temperature to 2400° K. The resistivity data obtained are represented as a linear function of temperature. A technique selected for thermal-conductivity measurements is presented, and the requisite apparatus is described.

A technique has been developed for simultaneously studying the interdiffusion between uranium carbides and four refractory metals—tungsten, niobium, tantalum, and molybdenum. The interactions between these metals and UC_2-UC mixtures have been studied at 1800° C for times up to 50 hr. Using carbon contents greater than stoichiometric UC has suppressed liquid-phase formation. The growth of uniform carbide layers was found to proceed according to a parabolic rate law, and layers as thick as 1000 μ were found after 50 hr. In addition to the formation of uniform carbide layers, severe carbide penetration of the grain boundaries was observed in niobium, tantalum, and molybdenum. Investigation of the interaction between UZrC (6.0 mol-% U:45.8 mol-% Zr:48.2 mol-% C) and the same four refractory metals at 1800° C after 50 hr. showed that the stabilization of the carbide phase by the addition of zirconium dramatically improves the diffusion characteristics. Author

07 CHEMISTRY

Includes: chemical analysis and identification (e.g., spectroscopy); chemical engineering; chemical properties of materials; and synthesis.

For related information see: 18 Materials, Metallic; 19 Materials, Non-metallic; and 26 Propellants and Combustion.

N63-13326 Frankford Arsenal. Pitman-Dunn Labs., Philadelphia, Pa.

COMPATIBILITY OF LUBRICANTS WITH MISSILE FUELS AND OXIDIZERS

Kurt R. Fisch (ASD. Materials Central, Wright-Patterson AFB), Louise Peale, Joseph Messina, and Henry Gisser Repr. from ASLE Trans., v. 5, 1962 p 287-296 11 refs Presented at the Annual Meeting of the Amer. Soc. of Lubrication Engineers (ASLE), St. Louis, May 1962
(Rept. A62-13)

Various compounds were studied to determine their suitability as lubricants in the presence of fuels and oxidizers used in missile systems. The classes of compounds studied were the halogenated aliphatic and aromatic hydrocarbons, the silicon and perfluorocompounds, esters, ethers, and compounds containing nitrogen. The fuels and oxidizers included ethyl alcohol, hydrocarbon fuel, unsymmetrical dimethylhydrazine, diethylenetriamine, a mixture of the latter two, hydrogen peroxide, inhibited red fuming nitric acid, and liquid oxygen. The most promising compounds were studied for their extreme pressure, antiwear, volatility, and viscometric properties. Three compounds were found to be completely inert (unreactive and insoluble) with all the fuels and oxidizers. One was a liquid (perfluorotributylamine) and the other two were solids (polytetrafluoroethylene and tetrafluoroethylene-hexafluoropropylene copolymer). The perfluorotributylamine exhibited adequate lubrication properties except for excessive volatility. The preparation of higher homologs of this compound is expected to remedy this shortcoming. The polytetrafluoroethylene and the copolymer may find application as components of a grease-type lubricant. Author

N63-13327 Frankford Arsenal. Pitman-Dunn Labs., Philadelphia, Pa.

FRIEDEL-CRAFTS REACTION OF FERROCENE WITH PHOSPHORUS TRICHLORIDE. FORMATION OF TRIFERROCENYLPHOSPHINE

Gilbert P. Sollott and Edgar Howard, Jr. Repr. from J. Org. Chem., v. 27, 1962 p 4034-4040 27 refs Presented in part at the Third Delaware Regional Meeting of the Amer. Chem. Soc., Philadelphia, Feb. 25, 1960
(Supported by the Army Research Office)
(Rept. A62-15)

The preparation of the first known compounds with phosphorus bonded to ferrocene carbon is described. The reaction of ferrocene with phosphorus trichloride in the presence of anhydrous aluminum chloride under conditions favoring mono-substitution gave rise to three products: ferrocenylphosphonous dichloride, diferrocenylphosphinous chloride, and triferrocenylphosphine. Formation of these compounds was demonstrated when the following derivatives were isolated: ferrocenylphosphinic acid; diferroncenylphosphinic acid and its hydrate; triferrocenylphosphine oxide, several of its hydrates, and a hydrogen chloride complex; and triferrocenylmethylphosphonium iodide. A tertiary phosphine was thus observed among the products of a Friedel-Crafts reaction for the first time. Infrared absorption bands were assigned to the ferrocenyl-phosphorus group. The possible existence of an interaction between phosphoryl and the ferrocene residues in the anhydrous phosphine oxide is discussed. Spectral evidence for ring hydration and ring hydrochlorination is presented. Author

N63-13328 Frankford Arsenal. Pitman-Dunn Labs., Philadelphia, Pa.

PARTIALLY FLUORINATED ALIPHATIC COMPOUNDS BY REDUCTIVE DESULFURIZATION OF SUBSTITUTED THIOPHENE

S. Portnoy and H. Gisser Repr. from J. Org. Chem., v. 27, 1962 p 3331 6 refs
(Rept. A62-16)

The preparation of partially fluorinated organic compounds via reductive desulfurization of appropriately substituted thiophene was investigated. Condensation of a fluoro acid chloride with a thienyl halide was accomplished by a reverse Grignard procedure. Conventional acid condensation techniques did not work. The resulting compound was desulfurized with Raney nickel yielding the aliphatic alcohol and ketone. The alcohol was dehydrated to the olefin and then hydrogenated to the saturated hydrocarbon. The Wolff-Kischner and Clemmensen reduction of the fluorinated ketone was unsuccessful. Author

N63-13341 Naval Research Lab., Washington, D. C.
ANALYSIS OF THE SPACECRAFT ATMOSPHERE [Interim Report]
R. A. Saunders Oct. 23, 1962 20 p 3 refs
(NRL-5816)

A study has been made of the nature of the contaminants introduced into the cabin atmosphere of a Project Mercury space capsule, external to the pressure suit, by the deliberately induced malfunction and overheating of certain parts of the capsule equipment during simulated flight. The contaminants were collected and concentrated by an adsorption-desorption cycle employing activated charcoal as the adsorbing medium. An analytical gas chromatograph was used to resolve the components of the contaminant mixture, which were then recovered individually from the effluent stream of the chromatograph and identified by means of their infrared spectra. Thirty-five components were detected in this atmosphere, 26 of which were identified. Approximate minimum concentrations have been indicated for the latter. The contaminant mixture comprised aliphatic and aromatic hydrocarbons, chlorinated hydrocarbons, and aliphatic alcohols, esters, and ketones. Some of the contaminants were present in sufficient concentration that reduction in the effectiveness or efficiency of an exposed pilot might occur. Author

N63-13374 Cincinnati U., Ohio
REACTIONS OF TRIPHENYLPHOSPHINIMINES WITH BORON COMPOUNDS, CERTAIN ORGANOMETALS, AND LEWIS ACIDS Technical Report No. 4
Hans Zimmer and Gurdial Singh Feb. 12, 1963 8 p 2 refs
(Grant DA-ARO-D-31-124 G122)
(AROD-2276-4)

Several triphenylphosphinalkylimines were reacted with BF_3, BPh_3, Me_2SnCl_2, and Ph_2SnCl_2. A new class of complexes containing a B-N or Sn-N bond was obtained. The stability of these complexes depended upon Me. The composition of the corresponding Sn-compounds corresponded to a 1:1 addition complex. The exact structure of these compounds is still under investigation. Author

N63-13375 Connecticut U., Storrs
TRANSANNULAR REACTIONS OF FREE RADICALS Final Technical Report, 16 June 1961-30 September 1962
Roy J. Gritters, Robert J. Albers, and Walter W. Hellmuth [1962] 49 p 36 refs
(Grant DA-ORD-14)
(AROD-2786-2)

Evidence to establish the geometry of an intermediate free radical was obtained from the free radical addition reactions of secondary cyclohexyl alcohols to an olefin. Three systems were investigated, namely, free radical of 1-octene reaction with 3-tert-butylcyclohexanol, 4-tert-butylcyclohexanol, and steroidal alcohols, viz., the 3-cholestanols and the 3-coprostanols. Both conformational isomers of the above alcohols were assigned and studied. The tertiary alcohols resulting from the addition reactions were isolated in yields expected for these starting materials (ca. 30%). In all the reactions, both of the possible isomeric tertiary alcohols were obtained, and their ratios were determined. Also studied was the ultraviolet-light-induced synthesis of cyclic compounds, as applied to the bicyclo-(2.2.1.)heptane ring system. Author

N63-13435 San Jose State College Foundation, Calif.
HIGH TEMPERATURE EQUILIBRIUM PROPERTIES OF TRANSITION METAL HALIDES Final Report
Laurence E. Wilson Feb. 1, 1963 7 p 4 refs
(Grant DA-ORD-31-124-60-G60)
(AROD-2757-1)

The total pressure of the gas phase above rhenium(III) chloride was determined as a function of temperature (ambient to 500° C) to determine the molecular stoichiometry of the vapor phase and the thermodynamic properties of the sublimation process. Purified samples of the compound were heated in Pyrex and quartz diaphragm gages by a resistance-type tube furnace. Gage temperatures were measured with chromel-alumel thermocouples. In every test where pressure measurements were made to temperatures above 360° C, higher pressures were recorded during cooling or during a subsequent heating of the sample than during the first heating. The sublimation process appears to be accompanied by simultaneous decomposition of rhenium(III) chloride to chlorine and either rhenium metal or a heretofore unreported lower halide ($ReCl_2$ or ReCl). The pressure of the decomposition product was corrected for by extrapolating from the residual pressure at 320° C and subtracting this number from the observed pressure. For the temperature range of 330° C to 500° C, the pressure of rhenium(III) chloride is tentatively reported to range from 0.15 to 19.2 (±2.3) mm Hg; and the standard heat and standard entropy of sublimation are reported as 29 ±7 kilocalories and 30 ±10 entropy units, respectively. R.C.M.

N63-13444 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
DETERMINATION OF WATER IN HYDRAZINE BY GAS CHROMATOGRAPHY
Daniel M. Kuwada Nov. 15, 1962 8 p 4 refs
(NASA Contract NAS7-100)
(JPL-TR-32-362) OTS: $1.10 ph, $0.50 mf

The gas chromatographic separation of water and hydrazine has been accomplished on a column of Fluoropak-80 coated with 20% Ucon Oil 550X. This separation was applied to the determination of small quantities of water in hydrazine. An automatic integrator was used to make the analysis rapid and reproducible. This analytical scheme is simple and accurate for concentrations of water in hydrazine, ranging from 0.5 to 2.0 wt. percent. Author

N63-13454 General Applied Science Labs., Inc., Westbury, N.Y.
ESTIMATED PROPERTIES OF LAMINAR WAKES WITH COUPLED RATE CHEMISTRY AND DIFFUSION
H. M. Bloom, R. W. Byrne, and E. D. Kennedy Sept. 18, 1962 33 p 6 refs Prepared for Lincoln Lab., MIT
(Contract AF 19(604)-7400; ARPA Order 13)
(GASL-TR-282; LL-37-16)

A selection of preliminary results of recent calculations of laminar, constant-pressure axisymmetric wakes, including chemical-diffusive coupling made for several full-scale flight and firing-range conditions, is presented. The analysis employs an integral method wherein the governing differential equations are satisfied exactly along the axis. The present chemical and thermodynamical models which consider N_2, N, O_2, O, NO, NO^+ and e^- species are more detailed than those usually used in connection with wake calculations. However, the following assumptions are retained: (a) vibrational equilibrium, (b) Fick's law of diffusion for each species, (c) a single representative Lewis number is taken constant and equal to 1.4, and (d) a constant value of the Prandtl number was taken as equal to 0.71. Author

N63-13455 General Applied Science Labs., Inc., Westbury, N. Y.
RESULTS OF DETAILED FLOW FIELD AND RATE CHEMISTRY CALCULATIONS ON AN AEROBALLISTIC PELLET
Arthur Fields Sept. 18, 1962 31 p 7 refs Prepared for Lincoln Lab., MIT
(Contract AF 19(604)-7400; ARPA Order 13)
(GASL-TR-292; LL-37-17)

The detailed supersonic flow field about an MIT firing-range pellet was computed by the method of characteristics. This characteristics solution yielded pressure distributions which were used as input to a nonequilibrium molecular dissociation analysis along the body streamline and several other external streamlines in the flow field. The effect of various flow-model assumptions on electron density along each streamline is presented, and electron density profiles across the shock layer are given for three axial stations. Author

N63-13461 Texaco Experiment Inc., Richmond, Va.
INVESTIGATION OF THE DISSOCIATION CHEMISTRY OF -NF_2 COMPOUNDS Quarterly Summary Report, Aug.-Oct. 1962
U. V. Henderson, Jr., and P. L. Goodfriend Nov. 1, 1962 14 p 5 refs
(Contract Nonr-1883(00))
(EXP-223; TM-1383)

Work has consisted entirely of apparatus construction. Two different techniques, thermal dissociation and photolytic dissociation, are now being planned for the study of the dissociation chemistry of -NF_2 compounds. The thermal dissociation will be done by adiabatic compression of a gas mixture with detection of the resulting species by time-of-flight mass spectrometry. The apparatus has been completed but has not yet been tested. The photolytic dissociation will be studied by kinetic spectroscopy. The necessary equipment for producing high-intensity photolyzing flashes and lower-intensity spectroscopic source flashes at precise time intervals has been assembled and tested. Complications in the construction of flash tubes have been encountered and are being overcome. Author

N63-13463 Cornell U., Ithaca, N.Y.
CHEMICAL KINETICS: A GENERAL INTRODUCTION
S. H. Bauer [1961] Repr. from Hypersonic Flow Research p 143-180 44 refs Presented at the ARS Intern. Hypersonics Conf., Cambridge, Mass., Aug. 16-18, 1961
(NASA Grant NsG-116-61; Contract AF 49(638)-716)

The discipline of chemical kinetics is briefly outlined. The relationships between the experimentally determined quantities and molecular parameters are reviewed, and attention is called to the fundamental assumptions. In hypersonic gas dynamics, with the fluid at the high temperatures and low densities, the half-times for chemical reactions are comparable to characteristic flow times. The corresponding terms which must be inserted in the flow equations appear as phenomenological rate constants. In the low-density regimes, the system should be described in molecular variables only; the chemical rate constants would then be replaced by averages over differential collision cross sections which are very sensitive to the molecular structures and the details of the collisions. Even for the simplest reactions, such expressions are very complex, and the data are insufficient to permit an adequate formulation. Gas-dynamic procedures have permitted the extension of rate measurements to temperatures and densities not ordinarily available to the chemical kineticist. In turn, these data allow the inclusion of real-gas effects in hypersonic flows. Selected examples show that, in addition, such data provide an impetus to theoretical chemists as well as critical tests for checking current theories. Author

N63-13471 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
KINETICS OF THE REACTION BETWEEN ALCOHOLS AND ISOCYANATES CATALYZED BY FERRIC ACETYLACETONATE
Leroy Schieler July 1, 1961 20 p 11 refs
(NASA Contract NASw-6)
(JPL-TR-32-129) OTS: $1.60 ph, $0.80 mf

The rate and temperature dependence of reaction for the ferric acetylacetonate catalyzed reaction between α-naphthyl, ortho-tolyl, and para-tolyl isocyanates and N-butyl alcohol are investigated. The effect of substituents on the reactivity of isocyanate and hydroxyl group is reported, and for substituted isocyanates is correlated by means of the Hammett equation. Several metal chelates were studied and their catalytic activity was compared to that of ferric acetylacetonate. All rate data are interpreted in terms of a mechanism involving simultaneous second-order uncatalyzed and catalyzed reactions between alcohol and isocyanate. Author

N63-13476 General Applied Science Labs., Inc., Westbury, N.Y.
HYPERSONIC AXISYMMETRIC WAKES INCLUDING EFFECTS OF RATE CHEMISTRY
M. H. Bloom and M. H. Steiger Sept. 18, 1962 113 p 17 refs Prepared for MIT Lincoln Lab.
(Contract AF 19(604)-4559)
(GASL-TR-180; LL-37-8)

The behavior of the uniform-pressure far-field wake is investigated. The flow is treated as a continuum by the boundary layer approximations. Chemical rate processes of air relative to atom-molecule dissociation and to ionization are taken into account. Calculations are made of the far-field laminar wake properties at the following trajectory points of a blunt body: 18,900 fps at 150,000 ft, 20,000 fps at 200,000 ft, and 20,400 fps at 250,000 ft. For these altitudes and flight velocities, it is shown that chemical rate effects are negligible with respect to mass-diffusion effects even in laminar flow for the primary air components (N_2, N, O_2, O, and NO) but not for the electron-producing process. Results of the investigation indicate that the ion species (α_{NO^+}) is definitely in a nonequilibrium state for both the supersonic expansion region and the wake, for flight velocities of about 20,000 fps and altitudes between 150,000 ft and 250,000 ft. B.J.C.

N63-13501 California Research Corp., Richmond
THE ANALYSIS OF POLYPHENYL RADIOLYSIS PRODUCTS BY GAS CHROMATOGRAPHY AND OTHER METHODS
W. W. West AEC Div. of Tech. Inform., Oct. 22, 1962 41 p 13 refs
(Contract AT(04-3)-248)
(TID-17508; AED-18) OTS: $1.00

This report presents techniques for the analysis of extremely complex radiolysis mixtures. These techniques are also applicable to the analysis of complex hydrocarbon mixtures in general. Gas chromatography proved to be extremely valuable for analyzing a wide range of polyphenyls and their radiolysis products. Gases, liquids, and solids up through the hexaphenyls have yielded to this technique. Two column packings of high selectivity were especially useful. Hydrogenated biphenyls and other unsaturated compounds were readily separated with poly(phenyl ether) columns useful at temperatures up to 220° C. For high temperature work (to 400° C) an inorganic salt eutectic of silver and potassium nitrates provided excellent service. This report includes: details of column construction and packing compositions, comparisons of the effectiveness of various column packings, chromatograph operating conditions, chromatographic retention times for a large number of polyphenyl radiolysis products, and several new sample introduction techniques. Methods other than gas chromatography are also discussed. The use of a mass spectrometer as an auxiliary gas chromatographic detector appears promising. Highly accurate determination of biphenyl, o- and m-terphenyls in mixtures can be achieved with adsorption chromatography. Author

N63-13532 Royal Norwegian Air Force. Inst. of Aviation Medicine, Blindern
A NEW REAGENT FOR QUANTITATIVE DETERMINATION OF BILIRUBIN AND OTHER TETRAPYRROLS
J. Fog and E. Jellum Dec. 1962 3 p 2 refs
(Rept. 62-2)

A photometric method is described for the quantitative determination of bilirubin. The reagent used in this method is MBTH (3 - methyl - 2 - benzothiazolon - hydrazone hydrachloride) which has recently been introduced for the determination of aliphatic aldehydes and pyrrole derivatives. A reaction mixture containing 0.5 ml of bilirubin in chloroform, 4 ml of isopropyl alcohol and 1 ml of 0.4% BS MBTH in water is allowed to stand for 5 minutes at room temperature. The color turns to blue-green when 1 ml of 1.3% ferric-chloride in 0.25 N HCl is added. After one hour the mixture is read in a spectrophotometer at 635 mμ against a blank. The extinction coefficient of the chromophore formed by the bilirubin-MBTH reaction is about 119,000 M/L/1 cm. R.C.M.

N63-13576 Argonne National Lab., Ill.
SOME FUNDAMENTAL ASPECTS OF VAPORIZATION
R. J. Ackermann, R. J. Thorn, and G. H. Winslow Dec. 1962 29 p 28 refs
(Contract W-31-109-eng-38)
(ANL-6663)

Problems of vaporization and condensation have been reviewed. Fundamental aspects of vaporization are presented along with a discussion of evaporation within the concepts of existing theories of solids and gases. An attempt is made to define those factors which can give rise to vaporization coefficients, to suggest where assumptions might be introduced to describe the coefficient phenomenon more completely, and to unify these within the phenomenological framework of irreversible thermodynamics. A.R.B.

N63-13580 Air Force Systems Command. Foreign Technology Div., Wright-Patterson AFB, Ohio
EFFECT OF ULTRASOUND ON NITROPARAFFIN-CARBONYL CONDENSATION
L. M. Kozlov, V. I. Burmistrov, and T. M. Khannanov Dec. 17, 1962 7 p 7 refs Transl. from Tr. Kazansk. Khim, Tekhnol. Inst. (Kazan), no. 26, 1959 63-66
(FTD-TT-62-1261/1+4)

A study is made of the effect of ultrasonics on condensation of nitroparaffins with ketones and aldehydes. The condensation of nitromethane with cyclohexane, acetone, and acetaldehyde, and that of 2-nitropropane with cyclohexane are considered. Ultrasonics do not spontaneously cause nitroparaffin-carbonyl condensation, but they do significantly increase the condensation rate of aldehydes and ketones with nitroparaffins when small amounts of bases are present. In this process the nitroalcohol yield also increases. J.R.C.

N63-13581 Air Force Systems Command. Foreign Technology Div., Wright-Patterson AFB, Ohio
COMBUSTION OF THE INORGANIC SALTS AMMONIUM IODATE AND HYDROXYL-AMINE SULFATE
A. A. Shidlovskiy Dec. 28, 1962 12 p 13 refs Transl. from Zh. Prikl. Khim (USSR), v. 35, no. 3, 1962 p 511-516
(FTD-TT-62-1604/1+2+4)

Chemical compounds not previously considered combustible were investigated to determine if stable combustion can be produced and, if so, under what conditions. Studies were made with ammonium iodate and hydroxylamine sulfate which normally decomposes slowly (several minutes) and release 72 kcal/kg and 120 kcal/kg, respectively. By igniting these compounds in the presence of catalysts at elevated temperatures (100° C) and at elevated pressure (120 atm) in the case of ammonium iodate, stable combustion was obtained. The burning velocity was 1.68 cm/sec for ammonium iodate and 0.07 cm/sec for hydroxylamine sulfate. R.C.M.

N63-13585 Air Force Systems Command. Foreign Technology Div., Wright-Patterson AFB, Ohio
A DEVICE FOR MEASURING ION CURRENTS IN MASS SPECTROMETER CIRCUITS
V. I. Rakhovskiy, A. P. Lyubimov, and S. I. Pavlov Jan. 17, 1963 5 p Transl. from Soviet Patent 144559 (685696/26), Nov. 15, 1960
(FTD-TT-62-1529/1+2+4)

A device that increases the measuring accuracy of ion currents in mass-spectrometer circuits is described. It uses one photomultiplier dynode as the converter of the ion current into an electron current. Soft β-radiations are measured on a Geiger counter. The device is intended to measure ion currents with an order of magnitude of 10^{-16} to 10^{-17} amps during mass-spectrometry investigations. I.v.L.

N63-13601 California U., La Jolla. Scripps Inst. of Oceanography
THE GENESIS OF THE LIGHT-DARK STRUCTURE IN THE PANTAR AND KAPOETA STONE METEORITES
Kurt Fredriksson and Klaus Keil [1962] 52 p 18 refs Presented at the Annual Meeting of the Mineralogical Soc. of America, Nov. 14, 1962 Houston, Tex. Submitted for Publication
(NASA Grant NsG-317-63)
OTS: $5.60 ph, $1.76 mf

The minerals and the texture of both light and dark portions in the Pantar chondrite and the Kapoeta achondrite were examined microscopically. The chemical composition of numerous grains of olivine, pyroxene, feldspar, nickel-iron, and troilite was measured by use of electron microprobe techniques. It was found that light and dark material in a given meteorite consists of the same minerals with identical composition, but the two portions differ markedly with regard to grain size. Generally, minerals in the dark portions are fine-grained, while the light material has normal texture and grain size. Single crystals of the light material occasionally extend into the dark part. These findings confirm that these types of meteorites are not polymict breccias, and further indicate that they result from shock brecciation of originally homogeneous rock bodies in an *in situ* transformation. The distribution of rare gases is tentatively ascribed to selective trapping in some recrystallized minerals in the dark part which have been more severely altered by the shockwaves. Author

N63-13639 Southern Research Inst., Birmingham, Ala.
A STUDY OF POLYMERS CONTAINING SILICON-NITROGEN BONDS Quarterly Progress Report No. 16 for the Period February 4 to May 3, 1962
Robert E. Burks, Jr., and Thomas W. Ray May 15, 1962 60 p 14 refs
(NASA Contract NAS8-1510)
OTS: $5.60 ph; $2.00 mf

Several silazanes have been tried as heat-barrier coatings. Several experimental coatings, when exposed to a radiant-heat source that delivered 40 Btu of thermal energy per square foot per second, transmitted heat more slowly than a standard sheet of asbestos impregnated with phenolic resin. One of the better coatings was a combination of a Silastic rubber and partially polymerized hexaphenylcyclotrisilazane. A method of comparing the hydrolytic sensitivities of silylamines has been developed. It is based on measuring the amount of ammonia or amine produced by hydrolysis. The method is simple and it is believed to be satisfactory for our studies. The condensation polymerization of hexaphenylcyclotrisilazane was shown to proceed almost exclusively by the elimination of benzene. Traces of several other materials including diphenyl and ammonia were produced. A solid diphenylsilylhydrazine polymer was prepared. It had a molecular weight of about 1100. Its stability and film-forming properties were not encouraging. A silicon-nitrogen compound was made from dimethylsilicon-diisocyanate and hexamethylcyclotrisilazane, but it was not polymeric. The product appeared to have slightly better hydrolytic stability than the reactants. The crystalline compound that had previously been made from silicon tetrachloride and methylamine was identified as 1,1,3,3,5,5 - hexamethylamino - 2, 4,6 - trimethylcyclotrisilazane. Although this compound is rather unstable to moisture and heat, there are possibilities that it will be valuable as an intermediate for synthesis of polymers. Author

N63-13646 Southern Research Inst., Birmingham, Ala.
A STUDY OF POLYMERS CONTAINING SILICON-NITROGEN BONDS Quarterly Progress Report for the Period May 4, 1962 to August 3, 1962 Semiannual Materials Report for the Period February 4, 1962 to August 3, 1962
Robert E. Burks, Jr. and Thomas W. Ray Aug. 15, 1962 58 p 12 refs
(NASA Contract NAS8-1510)
(Rept. 19) OTS: $5.60 ph, $1.94 mf

The hydrolytic sensitivities of silylamines have been compared by measuring the amount of ammonia or amine that is released when the silylamine in an organic solvent is shaken with water. The factors that improve hydrolytic stability are: phenyl substitution on silicon atoms, methyl substitution on nitrogen atoms, and polymerization. Chlorine substitution on phenyl rings attached to silicon is not beneficial. The amine exchange reaction was used to convert a mixture of hexamethylcyclotrisilazane and 1,1,3,3,5,5 - hexamethylamino - 2, 4,6 - trimethylcyclotrisilazane to polymers with molecular weights of 1500 to 1700. The hydrolytic stabilities of the polymers were decidedly better than those of the original compounds. Some silazane polymers having methyl groups attached to the silicon atoms were obtained from the reaction of dimethyldichlorosilane with ammonia. However, the main products were hexamethylcyclotrisilazane and octamethylcyclotetrasilazane. The polymers were more stable to moisture than the closely related simple cyclic compounds, and they were made into coatings of good stability by condensation polymerization. Further study of the condensation polymer of hexaphenylcyclotrisilazane provided additional support for the view that the polymer is formed by intermolecular elimination of benzene from silicon-phenyl and nitrogen-hydrogen groups. The condensation polymer evidently contains silicon atoms that are attached to one phenyl and three nitrogen atoms. Hexaphenylcyclotrisilazane was tried in several additional heat-barrier coatings. Hexaphenylcyclotrisilazene apparently is quite effective as a heat-sink and as an inert foaming agent, but it is brittle. Author

N63-13647 Southern Research Inst., Birmingham, Ala.

A STUDY OF POLYMERS CONTAINING SILICON-NITROGEN BONDS Progress Report for the Period August 4, 1962 to September 3, 1962

Robert E. Burks, Jr. and Thomas W. Ray Sept. 14, 1962 26 p 6 refs

(NASA Contract NAS8-1510)

(Rept. 20) OTS: $2.60 ph, $0.98 mf

Six samples of silicone rubber containing various amounts of hexaphenylcyclotrisilazane and Pyroshield 21, a component of intumescent paint, were prepared in sheet form and submitted to George C. Marshall Space Flight Center for trials as heat-barrier materials. A newly isolated byproduct of hexaphenylcyclotrisilazane was found to be a superior coating material in terms of thermal stability and ease of application to aluminum. The hydrolytic stability of 2,2,4,4,6,6,8,8 - octamethyl - 1,5 - dioxa - 3,7 - diazacyclooctasilane was slightly higher than that of hexamethylcyclotrisilazane. However, the oxoazacyclooctasilane was less stable than nonamethylcyclotrisilazane or hexaphenylcyclotrisilazane. A brittle, solid, infusible, insoluble polymer was produced by the amine exchange reaction of nonamethylcyclotrisilazane with 1,1,3,3,5,5 - hexamethylamino - 2, 4,6 - trimethylcyclotrisilazane. The polymer does not appear to have useful physical properties. The inclusion of methyltrichlorosilane in the reaction of dimethyldichlorosilane with methylamine produced only a small amount of polymer. Author

N63-13648 Southern Research Inst., Birmingham, Ala.

A STUDY OF POLYMERS CONTAINING SILICON-NITROGEN BONDS Progress Report for the Period September 4, 1962 to October 3, 1962

Robert E. Burks, Jr. and Thomas W. Ray Oct. 15, 1962 21 p 7 refs

(NASA Contract NAS8-1510)

(Rept. 21) OTS: $2.60 ph, $0.83 mf

A clear colorless resin was made by treating methyltrichlorosilane with methylamine and refluxing the product at temperatures up to 350° C. The resin was tough and hard at room temperature, but it softened on being heated slightly. It hardened to a vitreous stable solid on being heated to redness. Further studies are being made of its properties. Lithium derivatives of silazanes are being studied as intermediates in the synthesis of silicon-nitrogen polymers and compounds of improved stability and physical properties. The diisothiocyanates of silicon reacted with silazanes on prolonged refluxing, but no appreciable amounts of polymers were formed. The results were similar to those obtained with silicondiisocyanates. Author

N63-13649 Southern Research Inst., Birmingham, Ala.

A STUDY OF POLYMERS CONTAINING SILICON-NITROGEN BONDS Quarterly Progress Report for the Period August 4, 1962 to November 3, 1962

Robert E. Burks, Jr., and Thomas W. Ray Nov. 15, 1962 49 p 20 refs

(NASA Contract NAS8-1510)

(Rept. 22) OTS: $4.60 ph, $1.67 mf

In further studies of the hydrolytic stability of silicon-nitrogen compounds, it was found that attachment of phenyl or trimethylsilyl groups to the nitrogen atoms of hexamethylcyclotrisilazane was highly beneficial; a cyclic oxa-azasilane had greater stability than comparable cyclic silazanes; and two linear silylamines were less stable than a comparable cyclic compound. The degree of polymerization of silylamines was increased by reactions involving amine exchange and end-group condensation. However, the products were largely oils or solids with low softening points. A clear thermoplastic resin was produced by treating methyltrichlorosilane with methylamine and heating the product at 350° C. Further heating made the material partially insoluble and infusible. An n-trimethylsilyl derivative of hexamethylcyclotrisilazane was made but not purified. In the impure state, its rate of hydrolysis was considerably lower than that of hexamethylcyclotrisilazane, which showed that silylation of the nitrogen atoms is beneficial to stability. The possibility of modifying the reactivity of silazanes by n-silyation opens routes to new types of silicon-nitrogen polymers. A coating material that seems to have a better combination of properties was obtained as a byproduct of hexaphenylcyclotrisilazone preparation. It can be cured at 300° C, and has excellent adhesion and stability. The diisothiocyanates of silicon reacted with silazanes on prolonged refluxing, but no appreciable amounts of polymers were formed. The results were similar to those obtained with silicon-diisocyanates. Samples were prepared for trials as flexible heat barriers. The samples were silicone rubber into which varying amounts of hexaphenylcyclotrisilazone and Pyroshield 21 had been milled. Author

N63-13650 Southern Research Inst., Birmingham, Ala.

A STUDY OF POLYMERS CONTAINING SILICON-NITROGEN BONDS Progress Report for the Period November 4, 1962 to December 3, 1962

Robert E. Burks, Jr. and Thomas W. Ray Dec. 14, 1962 24 p 8 refs

(NASA Contract NAS8-1510)

(Rept. 23) OTS: $2.60 ph, $0.92 mf

In the study of factors affecting hydrolysis of silicon-nitrogen compounds, the beneficial effect of the phenyl rings was reemphasized by the exceptional stability of bis(anilino)diphenylsilane, which was comparable to hexaphenylcyclotrisilazane in resistance to hydrolysis. Bis(methylamino)diphenylsilane hydrolyzed much more quickly. A crystalline product was obtained from the reaction of methylamine with methyltrichlorosilane. It was so unstable, even at room temperature, that it was difficult to handle; and, therefore, it has not been fully identified. It and its byproducts polymerized on heating to a resinous solid that softened at about 100° C. The hexaphenylcyclotrisilazane byproduct was mixed with ethylenediamine silazane to form a flexible, colorless coating for aluminum and mild steel. The coating was heated at 700° F (370° C) for 18 hours without visible deterioration. The coated aluminum was protected even after being bent sharply and then exposed to 19% hydrochloric acid. Author

N63-13653 Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho

EVALUATION OF RADIATION STABILIZERS FOR TERPHENYL BY HIGH-TEMPERATURE ELECTRON IRRADIATION

H. A. Hartzfeld and R. B. Regier AEC National Reactor Testing Station, Jan. 21, 1963 15 p 4 refs

(Contract AT(10-1)-1080)

(IDO-16839) OTS: $0.50

The effectiveness of additives to reduce radiolytic damage to a mixture of isomeric terphenyls has been studied by a series of experiments in which 93 separate compounds were evaluated. The additives were tested at a low concentration (usually 3 mole percent) under irradiation at about 650° F with 6-Mev electrons from the Linac, to a dosage of 5 to 10 × 10^9 rads. Evaluations of the additives were based on comparison with control samples which were always irradiated simultaneously; their effectiveness was judged primarily by the relative polymer production, but relative gas production was also always determined. Results of the experimental work indicate that compounds which are effective to reduce polymerization may be classified into three categories: (1) Elemental sulfur, or a variety of compounds containing divalent or tetravalent sulfur, reduces polymer production to 75% to 88% of that in a control sample. (2) Fused-ring compounds structurally related to anthracene reduce polymer production to 73% to 89% of that in a control sample. (3) Hydrogenated or partially hydrogenated fused-ring compounds which do not necessarily have the structure of anthracene reduce polymer production to 75% to 93% of that in a control sample. Author

N63-13666 Gt. Brit. Ministry of Aviation. Technical Information and Library Services, Mottingham

MAXIMUM RATE OF BURNING OF POTASSIUM PICRATE UNDER PRESSURE VARIATION [O MAKSIMUME SKOROSTI GORENIYA PIKRATA KALIYA PRI IZMENENII DAVLENIYA]

A. F. Belyaev and Y. A. Kondrashkov Feb. 1963 5 p 5 refs Transl. from Doklady Akad. Nauk SSSR (Moscow), v. 131, no. 2, 1960 p 364-366

(TIL/T.5390)

At low pressures the combustion of potassium picrate increases rapidly with pressure, but the rate is not pressure-dependent at high pressures. A more exact, experimental analysis is made of the relationship. The rate rapidly reaches a maximum, becomes linear, and then decreases to a constant value at 25 atmospheres pressure. The behavior of mixtures of picrate with perchlorate was also examined. Author

N63-13690 Royal Aircraft Establishment, Farnborough (Gt. Brit.)

ON THE PROBLEM OF THE CRYSTALLIZATION OF NATURAL RUBBER (K VOPROSU O KRISTALLIZATSII NATURAL'NOGO KAUCHUKA)

B. Ya. Teitelbaum, E. F. Gubanov, and V. A. Naumov London, Ministry of Aviation, Dec. 1962 7 p 9 refs Transl. by K. F. Rogers from Doklady Akad. Nauk SSSR (Moscow), v. 145, no. 5, 1962 p 1077-1080

(RAE Library Translation-1021)

Graphs of the variation of strain with temperature for constant and periodic loads are presented for specimens of natural rubber conditioned at various temperatures. It is shown that the melting temperature of crystallites in rubber depends upon their temperature of formation. It is concluded that although natural rubber crystallizes in the same lattice at all temperatures, faster cooling produces non-equilibrium crystallites melting at lower temperatures. X-ray photographs are presented in support of these conclusions. Author

N63-13706 Aerojet-General Nucleonics, San Ramon, Calif.

HYDRAZINE PROCESS DEVELOPMENT Interim Technical Engineering Report, August through October 1962

F. R. Standerfer, H. J. Snyder, H. T. Watanabe, L. G. Carpenter, R. I. Miller, and R. L. Pearson Wright-Patterson AFB, Ohio, ASD [1962] 218 p 19 refs

(Contract AF 33(600)-42996)

(ASD-TR-7-840A(VII); AGN-AN-756)

The primary goal of this program is to develop, design, construct, and operate a continuous, in-reactor, hydrazine-production loop based on the fission chemical-process approach. This report discusses fission-fragment distribution studies, colloidal UO_2 preparation, improvements in uranium and hydrazine analytical techniques, in-reactor loop-design modifications, fission-fragment deposition measurements for a variety of sources, correlation of experimental heat-transfer data, and a parametric reactor-systems analysis. B.J.C.

N63-13739 Gt. Brit. Ministry of Aviation. Technical Information and Library Services, Mottingham

INVESTIGATIONS OF NITROGEN-CHLORIDE COMPOUNDS. NITROGEN-MONOHYDRIDE AS AN INTERMEDIATE PRODUCT OF THE DECOMPOSITION OF CHLORAMINE (STICKSTOFF-MONOHYDRID ALS ZWISCHENPRODUKT DER CHLORAMINZERSETZUNG)

J. Jander and J. Fischer Feb. 1962 11 p 16 refs Transl. from Z. Anorg. Allgem, Chem., (Leipzig), v. 313, 1961 p 37-47

(TIL/T-5368)

Solid chloroamine has been decomposed at −190° C by ultraviolet irradiation. The blue product formed is stable below −150° C. This result is supported by the identification of hydrogen cyanate during the thermal decomposition of gaseous chloroamine in the presence of carbon monoxide (5 to 10 mm Hg, 500° C). Under the same conditions, hydrazine also produces hydrogen cyanate. Studies have shown that nitrogen monohydride and ammonia react to form hydrazine, therefore it is experimentally possible to synthesize hydrazine from chloroamine and ammonia by way of the intermediate product nitrogen monohydride. Author

N63-13755 Texaco Experiment Inc., Richmond, Va.

PREPARATION AND CHARACTERIZATION OF HIGH-PURITY SINGLE-CRYSTAL BORON [Final Report, Mar. 1961-Feb. 28, 1962]

Irving R. King, Gerald R. Taylor, Jr., Frank E. Wawner, Jr., and Calude P. Talley Wright-Patterson AFB, Ohio, Directorate of Materials and Processes, Jan. 1963 47 p 9 refs

(Contract AF 33(616)-7884)

(ASD-TDR-62-427)

Crystalline boron specimens about 3 to 4 mm in diameter and several centimeters in length were prepared by chemical vapor plating and subsequently floating-zone melted. X-ray-diffraction studies showed them to be the β-rhombohedral phase and single crystalline over most of the zone-melted portions. Electrical and optical measurements were made on some of the boron single crystals produced. Author

N63-13761 Texas A. and M. Coll. Activation Analysis Res. Lab., College Station

AN INVESTIGATION OF COMPUTER COUPLED AUTOMATIC ACTIVATION ANALYSIS AND REMOTE LUNAR ANALYSIS Quarterly Progress Report, November 1, 1962-February 1, 1963

Lloyd E. Fite, Edgar L. Steele, Richard E. Wainerdi, Edward Ibert, and Wayne Wilkins Feb. 1, 1963 66 p 4 refs
(NASA Grant NsG-256-62; Contract AT(40-1)-2671)
OTS: $6.60 ph, $2.18 mf

An investigation of computer coupled automatic activation analysis includes: (1) a detailed description of the Mark II logic circuits governing the sequence of steps in the operations of the system; (2) the use of long half-life radioisotopes in tests of the precision and reliability of the analyzer and printout of the Mark I system; and (3) the use of the Mark Ia system for silver determination in rat brain homogenate and for selenium determination in blood and urine.

Results of remote lunar analysis, investigation indicates that: (1) Fast neutron irradiation of aluminum, iron, magnesium, oxygen, and silicon systems yields gamma ray spectra which can be resolved into elemental components with a 400-channel scintillator spectrometer. (2) The utilization of a collimated detector provides a defined sensitive volume of radioactive material from an infinitely large sample. From the known volume and a measured density, sample masses can be calculated. (3) Once a constant for a given set of irradiation conditions has been determined for each element, mixtures can be analyzed using these constants, as long as the irradiation conditions remain the same. I.v.L.

N63-13762 European Atomic Energy Community, Brussels (Belgium)
MICROANALYSE A SONDE ELECTRONIQUE D'ECHANTILLONS RADIOACTIFS [QUANTITATIVE ELECTRON MICROPROBE ANALYSIS OF RADIOACTIVE MATERIALS]
J. P. Lecoq and R. Theisen Joint Nuclear Research Center, Ispra Establishment, (Italy), Dec. 1962 11 p 8 refs In French; English abstract
(EUR 118.f) Available from the Belgian American Bank Trust Co., N.Y., account No. 121.86: 30 Belg. Fr.

The analytical possibilities of an electron probe microanalysis in the presence of radioactive and irradiated materials have been studied. For the quantitative microanalysis of α emitters in an electron beam probe equipped with fully focalised spectrometers, a relatively simple method is proposed. The analysis of irradiated samples requires slight modifications of the commercial instruments, involving, in particular, the use of a proportional counter followed by a pulse-height selector, the use of a special specimen holder and judiciously placed lead screens, an orientable crystal press, and short inter-reticular distance analyzing crystals. Author

N63-13763 European Atomic Energy Community, Brussels (Belgium)
PHYSICOCHIMIE DE LA MIGRATION DE CATIONS DANS LE SOL [PHYSICAL CHEMISTRY OF THE MIGRATION OF THE CATIONS INTO THE GROUND]
L. Baetsle Jan. 1963 25 p
(Euratom Contract 048-61-4 RDB)
(EUR-141.f) Available from Belgian-American Bank and Trust Co., N.Y., account No. 121.86: 40 Belg. Fr.

Studies have led to the development of new methods for establishing the variation of the distribution coefficient in a natural ion exchanger using three macroscopic ions. The determination methods of the relative velocities of radioactive cations in soils have been investigated comparatively. No definite method has been found for the case of continuous discharge into the ground. For the migration of radionuclides in a natural environment, the calculation method based on the static distribution coefficient seems to be adequate. The analogy between the hydrodynamic and physicochemical dispersion is examined in order to determine the relation between the parameters describing the phenomena. Some practical cases are presented. Author

08 COMMUNICATIONS

Includes: communications equipment and techniques; noise; radio and communications blackout; telemetry; tracking; and wave propagation.

For tracking stations see: 10 Facilities.

For related information see: 06 Auxiliary Systems; 09 Electronics; 15 Instrumentation; and 22 Navigation and Guidance.

N63-13340 Airlines Communications Administrative Council. Airlines Electronic Engineering Committee, Washington, D. C.
RADIO ALTIMETER. ARINC CHARACTERISTIC NO. 552
Nov. 1, 1962 61 p 36 refs

The basic requirements are set forth for a radio altimeter system that is suitable for monitoring and display use, or for autopilot tie-in and that covers the range from ground level to a height of 2500 feet. The system described is intended to inform prospective manufacturers and to channel new equipment designs in the direction of maximum possible standardization. The standards required to ensure interchangeability are given along with the system design and performance requirements. R.C.M.

N63-13363 Air Force Systems Command. Electronics Systems Div., Bedford, Mass.
PRESENT AND FUTURE MILITARY OPERATIONAL APPLICATIONS; CODES NOW IS USE; THE CONVERSION PROBLEM
Robert E. Winters *In* Radio Technical Commission for Aeronautics, Wash., D.C. Minutes of Fall 1962 Assembly Meeting, Marriott Motor Hotel and the Naval Research Lab., Wash., D.C., Nov. 27-29, 1962 Dec. 5, 1962 6 p (See N63-13356 08-01)
(Paper 175-62/AS-247)

A Ground Aerospace Ground Digital Communications System, being designed by the Air Force Systems Command, to support Air Force operations is discussed. Advantages of digital communication systems, such as the GAG system, over voice operations are given. Emphasis is placed on use of GAG systems for the following communications applications: automation, security, record, and transmission reliability and efficiency. B.J.C.

N63-13364 Air Transport Assn. of America, Washington, D.C.
CIVIL USER OPERATIONAL APPLICATIONS OF AIR-GROUND DIGITAL COMMUNICATIONS
Frank C. White *In* Radio Technical Commission for Aeronautics, Wash., D.C. Minutes of Fall 1962 Assembly Meeting, Marriott Motor Hotel and the Naval Research Lab., Wash., D.C., Nov. 27-29, 1962 Dec. 5, 1962 6 p (See N63-13356 08-01)
(Paper 176-62/AS-248)

An all-purpose, automatic, digital-communications system, which is capable of communicating all air-ground requirements is suggested. Applications discussed include use of these systems for automatically communicating the time out, time off, time on, and time in of the aircraft to the correct locations for subsequent use. Also, advantages are given of such a system, over oral-manual systems, for ground-to-air selective calling. Advantages include: (1) delivery of hard copy checked for error to the cockpit and also communicated at high speed; (2) delivery of communications to the cockpit without requiring the attention of any crew member; (3) providing automatic, immediate receipt to the originating office for communications delivered to the aircraft; (4) originating, routing, and delivering communications in a single, digital form. B.J.C.

N63-13365 Western Union Telegraph Co., New York, N.Y.
THE GROUND ENVIRONMENT OF AN INTERNATIONAL DATA LINK SYSTEM
J. Z. Millar *In* Radio Technical Commission for Aeronautics, Wash., D.C. Minutes of Fall 1962 Assembly Meeting, Marriott Motor Hotel and the Naval Research Lab., Wash., D.C., Nov. 27-29, 1962 Dec. 5, 1962 6 p (See 13356 08-01)
(Paper 177-62/AS-249)

The ground environment necessary for an international data link system is discussed. Systems of this type require a closely integrated operating system and therefore careful consideration must be given to the ground environmental aspects of the system design. International data link system requirements also include a projection of both civilian and military operational needs; therefore, the system must provide a capability satisfying these needs both with respect to the radio data links and the ground support system. Specifically, the system design must comprehend an overall capability both in space and on the ground of transmitting data for the purposes of civilian and military air traffic control, and military command and control, including information transfer as required. B.J.C.

N63-13366 Aircraft Radio Corp., Boonton, N.J.
AIRBORNE ELECTRONIC CONCEPTS
Edward B. Moore *In* Radio Technical Commission for Aeronautics, Wash., D.C. Minutes of Fall 1962 Assembly Meeting, Marriott Motor Hotel and the Naval Research Lab., Wash., D.C., Nov. 27-29, 1962 Dec. 5, 1962 5 p (See N63-13356 08-01)
(Paper 178-62/AS-250)

Planning for integrated communication-navigation systems is discussed. Improved planning for a system of this type should include ways to improve the method of displaying information; i.e., presentations should be combined in a lesser number of instruments. Currently, altitude, attitude, heading, navigational position information, and frequency channels are all displayed on separate instruments in many aircraft. Also, plans must take into consideration use of equipment which is patterned to all aircraft ranging from the light, two-place, single-engine class to the transport and high-performance military classes. B.J.C.

N63-13377 Navy Electronics Lab., San Diego, Calif.
CORRELATION BETWEEN THE MINIMUM VIRTUAL E-LAYER HEIGHT h'E AND THE 100-mb CIRCULATION
V. R. Noonkester Jan. 22, 1963 28 p 5 refs
(NEL-1155)

A study was conducted to examine the correlation between the minimum virtual E-layer height h'E at Washington, D.C., and the stratospheric circulation over the Eastern U.S. as a function of frequency and scale size of the circulation. The minimum virtual E-layer height was found to be correlated with a particular type of large-scale circulation at the 100-mb level which has a period of 6.3 days. One of the ten circulation indices used to describe the 100-mb circulation was found to have predominant periods of 22 and 12 days. Author

N63-13379 Navy Electronics Lab., San Diego, Calif.
SIMULATANEOUS MULTIBEAM PHASE COMPENSATION. XI. A RESISTIVE-ELEMENT PHASE COMPENSATOR Research and Development Report, Feb. 1958-Oct. 1958
L. D. Morgan and R. D. Strait Dec. 4, 1962 53 p 18 refs Submitted for Publication
(NEL-1148)

A single-beam, resistive-element phase compensator network was designed and constructed for the 48-element array of the AN/SQS-4 Mod 3 sonar with half-wavelength spacing. It demonstrated satisfactory operation throughout the frequency range within ±17 percent of the design frequency, yielding beam patterns similar to the transformer phase-compensator patterns obtained in the same way. Theory and design details are discussed fully. Author

N63-13423 Johns Hopkins U. Caryle Barton Lab., Baltimore
SIGNAL ANALYSIS II: ESTIMATION OF THE AMPLITUDES OF NARROW-BAND DETERMINISTIC SIGNALS OBSERVED INCOHERENTLY IN NOISE BACKGROUNDS
David Middleton Feb. 1963 111 p 14 refs
(Contract AF 33(616)-6753)
(AF-100)

Two principal regions of operation are distinguished: weak-signal reception, where the output signal-to-noise ratio is order unity or less, and strong-signal reception, which includes the case of critical interest; that is, threshold operation, in which, although the input signal is weak, the processing gain (or effective time-bandwidth product) is sufficiently large to ensure a large effective signal output. For this latter mode of operation, a variety of canonical results is obtained. Subject to weak conditions with respect to the a priori amplitude distribution density $w(a_o)$ and choice of cost function, it is found that (as processing gain $\to \infty$) the optimum (or Bayes) estimator of amplitude $\gamma = a_o$ is asymptotically invariant of this a priori distribution density $w(a_o)$ and of the choice of cost function; a_o is minimax and converges mean-square. This estimator is also unbiased, has an unconditional distribution density which is the same as the a priori distribution density, that is, $w(a_o)$, and yields a simple canonical result for the interval estimate of amplitude. Author

N63-13426 Instituto Geofisico del Peru. Observatorio de Huancayo
RIOMETER RECORDS OF 30 MC/S. COSMIC NOISE AT HUANCAYO—PERU Final Technical Report, June 17, 1961-September 28, 1962
Alberto A. Giesecke Dec. 1962 61 p 3 refs
(Grant AF-AFOSR-61-83)

This report contains: (1) riometer records of 30 mc/s cosmic noise resulting from an increase in electron density due to solar flare effects and (2) a discussion of the detection and measurement of synchrotron noise caused by the emission of electromagnetic energy by spiraling electrons which were produced during a fission explosion within the megaton range. I.v.L.

N63-13480 Federal Aviation Agency. Systems Research and Development Service, Atlantic City, N.J.
TEST AND EVALUATION OF A RADAR PARAMETRIC AMPLIFIER Final Report
William Herget May 1962 40 p 3 refs

An experimental model of an S-band, one-port, semiconductor-diode parametric amplifier, designed and manufactured by the Airborne Instruments Laboratory, was evaluated at the National Aviation Facilities Experimental Center (NAFEC) to determine its applicability for field use to improve reliability of detection of small targets. The laboratory tests included measurements of noise figure, gain, bandwidth, and gain stability. System tests provided data on reliability, effects of interference, relative increase in radar range and sensitivity, and MTI performance. The results were tabulated and are presented in graphic and pictorial form. Analysis of data collected from these tests indicates that the parametric amplifier meets the development goals. Author

N63-13484 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
RADAR EXPLORATIONS OF VENUS
Richard M. Goldstein May 25, 1962 43 p 10 refs
(NASA Contract NAS7-100)
(JPL-TR-32-280) OTS: $4.60 ph, $1.49 mf

The feasibility of studying Venus by radar was demonstrated on March 10, 1961, when an echo from Venus was first detected in real time. The spectrum of the echo may be expected to be broadened by the Doppler shifts produced by any rotation of Venus. In order to measure this broadening, a novel technique for accurate spectral estimation of this extremely weak signal was

devised, analyzed, and implemented. The results of the measurements indicate that Venus rotates very slowly, perhaps only once during each of its years, so that one hemisphere always faces the sun. In addition, the spectral measurements together with some polarization measurements enable one to infer some scattering properties of the surface. Time-of-flight measurements were also made, using a cross-correlation technique. These, compared with standard astronomical tables, provide a new value for the Astronomical Unit. The standard deviation of these measurements is only a few parts in 10^7. Author

N63-13590 Utah State U. Antennas and Propagation Lab., Logan
A THEORETICAL AND EXPERIMENTAL INVESTIGATION OF FLUSH MOUNTING CONFIGURATIONS FOR LOG PERIODIC STRUCTURES Interim Report [July 1-December 31, 1962]
Clayton Clark, William L. Jones, and Allen Leigh Jan. 1, 1963 78 p 54 refs
(NASA Grant NsG-221-62)
OTS: $7.60 ph, $2.54 mf

CONTENTS:

1. THE INFLUENCE OF THE CONDUCTING CAVITY UPON THE IMPEDANCE AND RADIATION PROPERTIES OF A LOG PERIODIC ANTENNA-CAVITY ASSEMBLY Allen W. Leigh 1962 p 50-78 8 refs (See N63-13591 08-08)

N63-13591 Utah State U. Antennas and Propagation Lab., Logan
THE INFLUENCE OF THE CONDUCTING CAVITY UPON THE IMPEDANCE AND RADIATION PROPERTIES OF A LOG PERIODIC ANTENNA-CAVITY ASSEMBLY
Allen W. Leigh 1962 38 p 8 refs *In its* A Theoretical and Experimental Investigation of Flush Mounting Configurations for Log Periodic Structures (See N63-13590 08-08) OTS: $7.60 ph, $2.54 mf
(NASA Grant NsG-221-62)

A monopole-tooth log periodic antenna, mounted flush with the opening of a wedge cavity, was tested to determine the effect of physical changes in the cavity width, floor angle, and back wall angle on its impedance and radiation characteristics. The frequency response of the useful impedance region is not greatly affected by any cavity change, but the diameter of the average impedance spiral is greatly affected by any cavity change. The antenna radiation parameters are greatly affected by changes in the angle of the floor but only slightly or moderately affected by changes in the half-width and back wall of the cavity. R.C.M.

N63-13623 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
TRACKING TECHNIQUES FOR INTERPLANETARY SPACECRAFT
R. P. Mathison Aug. 1, 1962 25 p 11 refs
(NASA Contract NAS7-100)
(JPL-TR-32-284) OTS: $2.60 ph, $0.95 mf

The tracking of interplanetary spacecraft is accomplished by a reference receiver system based on the principle of an automatic phase-control servo, in which the phase of a local oscillator signal is adjusted to be in quadrature with the phase of the input signal. Some of the properties of this type of servo related to the tracking applications are discussed. The measurement of spacecraft position and motion is implemented by simultaneous measurement of the Doppler frequency shift, phase shift, and apparent angles-of-arrival of phase-modulated CW signals, using the accurate two-way technique mandatory for the increasingly precise trajectories of current missions. An extension of this two-way technique makes use of the cross-correlation properties of binary waveforms to measure the range to interplanetary spacecraft. The angular positions of spacecraft are determined by measuring the apparent angles-of-arrival of the transmitted signals. Simultaneous-lobing antennas of the amplitude-comparison type are used for this purpose in conjunction with coherent error-detection receivers. The future improvements required in the tracking system in order to instrument the exploration of the solar system adequately are considered. Author

N63-13641 Chalmers U. of Tech. Research Lab. of Electronics, Goteburg (Sweden)
DYNAMIC NON-LINEAR WAVE PROPAGATION IN IONIZED MEDIA. 5. REFLECTION OF ELECTROMAGNETIC WAVES FROM AN IONIZED STREAM IN THE PRESENCE OF A HIGH POWER PRIMARY WAVE
K. H. B. Wilhelmsson 1962 74 p 9 refs Includes catalogue of 92 R.L.E. publications
(Contract AF 61(052)-451)
(Res. Rept. 31; US-30; AFCRL-62-969)

The electromagnetic interaction of an ionized stream with two incident plane waves of different frequencies is studied theoretically, with particular reference to lowest order mixed-frequency components. One of the two incident plane waves is assumed to propagate perpendicular to the direction of the drift velocity whereas the other wave is allowed to have an arbitrary angle-of-incidence. The presence of an infinitely strong magnetic field in the direction of the drift velocity is further assumed. The investigation covers the planar and cylindrical cases. The possibility of resonances of the mixed-frequency field components is demonstrated. Author

N63-13694 Illinois U. Antenna Lab., Urbana
PROPAGATIONAL PHASE VARIATION MEASUREMENTS AT VERY LOW FREQUENCIES Scientific Report No. 17
James Lester Knox (Ph. D. Thesis) Oct. 31, 1962 124 p 42 refs
(Contract AF 19(604)-7270)
(Rept. 1116-26; AFCRL-63-44)

Very low radio frequencies have been widely used for long-range communications since the earliest days of radio. A system is described for obtaining relative phase delay measurements at two points separated by 1800 kilometers. Rubidium vapor oscillators are used as extremely stable phase references for the servocontrolled phase-lock measurement system. Experimental results include phase records of transmissions received at 20 kc over a 1800-km path, at 18 kc over a 3450-km path, and at 16 kc over a 6100-km path. A statistical analysis of the propagational phase variations of these signals for a sample two-week period is included. Author

N63-13697 Illinois U. Antenna Lab., Urbana
BACKWARD-WAVE RADIATION FROM PERIODIC STRUCTURES AND APPLICATION TO THE DESIGN OF FREQUENCY-INDEPENDENT ANTENNAS
P. E. Mayes, G. A. Deschamps, and W. T. Patton Dec. 1962 72 p 10 refs
(Contract AF 33(657)-8460)
(Tech. Rept. 60)

The operation and capabilities of a number of uniformly periodic antennas are explained so as to facilitate understanding of the operation and potential capabilities of unidirectional frequency-independent log-periodic antennas. One characteristic common to a large number of these frequency-independent antennas is that radiation is directed toward the apex or feedpoint of the structure. Therefore, to facilitate an understanding of this characteristic, this report treats the log-periodic antenna as a locally periodic structure whose period varies slowly, increasing linearly with distance from the apex. Among the notable properties of periodic antennas are the frequency-scanning capability of some of these structures and the absence of sidelobes in the backfire mode. The backfire property is required of the periodic structure to allow tapering to a successful log-periodic antenna. Results of this study show that it should be possible to satisfy most log-periodic antenna specifications as to polarization, gain, and bandwidth. For example, a gain equivalent to the gain of a linear

array of dipoles with Hansen-Woodyard excess phase shift has been obtained with a backfire bifilar helical antenna with a pitch angle of 45 degrees. This antenna has a very narrow bandwidth for this gain. However, gains of this order should be obtainable with the log-periodic version of this antenna if an extremely slow rate of taper were used. In this way, high gain and large bandwidth antennas could be built but at the expense of very large structures. B.J.C.

N63-13699 Federal Aviation Agency. Systems Research and Development Service, Atlantic City, N. J.

EVALUATION OF A HONOLULU TERMINAL RADAR SERVICE AREA AND THE HAWAIIAN ISLANDS DOMESTIC ENROUTE AREA Final Report

R. Cassell, R. Conway, L. Douglass, J. Maurer, and R. Stephens Dec. 1962 129 p

This report describes the evaluation of a Honolulu Terminal Radar Service Area and proposed modifications of the present enroute traffic flows and airway structure within the Hawaiian Islands Domestic Control Area. Procedural plans, the extent of service, and the optimum equipment configuration for use in the Honolulu IFR room, were developed during the Terminal Radar Service Area evaluation. Two modified airway structures were evaluated for the northeast and east enroute areas. The existing airway structure was used in evaluating a proposed traffic flow for the west enroute area. The evaluation was conducted using the Model 1 Dynamic Air Traffic Control Simulator at the National Aviation Facilities Experimental Center, Atlantic City, New Jersey. The results indicated that a Honolulu Terminal Radar Service Area is feasible. However, additional equipment and control positions would be required to provide the degree of extended radar service within the Honolulu Terminal Radar Service Area as simulated. The proposed modifications to airway structure and routings appeared to offer only slight advantages over the existing system. Author

N63-13709 Harry Diamond Labs., Washington, D.C.

MICROWAVE PHASE COMPARATOR

H. B. Smith, Jr., (Keyport Navy Torpedo Sta., Bremerton, Wash.) J. A. Kaiser, W. H. Pepper, and J. H. Little 1962 8 p Presented at the 6th National Convention on Military Electronics, Wash., D.C., June 25-27, 1962

A new method for passively measuring phase between two signals of the same frequency is described. The system has no ambiguities throughout 360° and is independent of relative signal amplitudes. Consisting principally of two hybrids with detectors, the system contains no moving parts or variable phase shifters. Author

N63-13728 Federal Aviation Agency. Systems Research and Development Service, Atlantic City, N.J.

EXPERIMENTATION ON IMPROVED GROUND EQUIPMENT FOR 50-KC VOR CHANNEL SPACING Final Report

J. E. Blazej May 1962 43 p 3 refs

Laboratory, field, and flight tests were conducted to aid in determining the practicability of utilizing 50-kilocycle channel spacing in an operational VOR environment. Relative interference effects of an adjacent channel interfering station, with both normal and reduced harmonic content, were determined by means of the flight-test program. The test data indicated that reduction of the harmonic content resulted in improved VOR performance. Author

09 ELECTRONICS

Includes: circuits and circuit theory; electronic components (e.g., tunnel diodes, transistors, and tubes); and feedback and control theory.

For related information see: 06 Auxiliary Systems; 08 Communications; 15 Instrumentation; 22 Navigation and Guidance; and 25 Physics, Solid-State.

N63-13584 Air Force Systems Command. Foreign Technology Div., Wright-Patterson AFB, Ohio

A SHIFT REGISTER-DECODER

Ye. M. Martynov Jan. 10, 1963 6 p Transl. from Soviet Patent 131777 (647108/26), Dec. 14, 1959
(FTD-TT-62-1436/1+2+4)

A magnetic core shift register-decoder with a square hysteresis loop and transistors is described. Decoding windings, which are equal in number to the number of decoder outputs, are placed on each magnetic core in order to decrease the number of circuit elements. The bases of the transistors are connected in series with the decoding windings and the windings of the "one" generator. The decoding principle is based upon a comparison of the voltage induced in the code windings by cadence pulses with the reference voltage obtained by the "one" generator. I.v.L.

N63-13628 Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho

THE TUNNEL DIODE AS A FAST DISCRIMINATING SWITCH

Clayton L. Miller AEC National Reactor Testing Station, Dec. 5, 1962 10 p 1 ref
(Contract AT(10-1)-205)
(IDO-16823) OTS: $0.50

The application of tunnel diode discriminators to high pulse-rate-counting circuitry imposes special requirements on the associated counting apparatus. Some circuit modifications are discussed which are desirable for the use of tunnel diode discriminators to accept high-level data pulses in the presence of a high rate of low-level background pulse (i.e., to prevent pulse pile-up), and in another application to discriminate against low-level pulses in the presence of a high rate of data pulses (i.e., discrimination without significant loss of resolving time). Author

N63-13698 Illinois U. Antenna Lab., Urbana

ANTENNA IMPEDANCE MATCHING BY MEANS OF ACTIVE NETWORKS

S. Laxpati and R. Mittra Nov. 1962 54 p 10 refs
(Contract AF 33(657)-8460)
(Tech. Rept. 64)

Several schemes for wideband matching of impedances, using active elements in the matching network, are introduced. It is shown that the design procedure is a straightforward one when two active elements such as negative impedance converters are used. An alternate scheme using one active element is also discussed, and it is shown that a RC matching circuit using Kinariwala's synthesis technique usually obtains a rather complicated, and sometimes impractical, type of network. However, a simple LC matching network may be designed using one active element if certain approximation of the load impedance function is made. Illustrative designs using one and two active elements are described. The noise performance of an active matching circuit which has an infinite bandwidth in an ideal sense is compared with a simple active padding network. It is found

that there is little relative advantage of one over the other. There is, however, a definite advantage of the former circuit over the latter if their power performance is compared. Experimental verification of the theoretical designs is included. Author

N63-13705 Cutler-Hammer, Inc. Airborne Instruments Lab., Deer Park, N.Y.

SECOND QUARTERLY PROGRESS REPORT ON SOLID-STATE CIRCUITS

E. W. Sard, K. Siegel, W. W. Heinz, S. Hamilton, and S. Okwit Oct. 1962 60 p 12 refs
(Contract AF 30(602)-2699)
(Rept. 1654-I-2; RADC-TDR-62-547)

Two types of broadband solid-state limiters for protecting receivers operating in the 400- to 800-mc range are being investigated—ferrite limiters and varactor-diode limiters. Single-crystal gallium-substitute yttrium-iron garnet (gallium-YIG) having a saturation magnetization ($4\pi M_s$) of 420 gauss has been considered for the ferrite limiter. It was found that the crystal has relatively high first- and second-order normalized anisotropy constants (about -110 and -30 oersteds) and large linewidths (about 30 oersteds). Measurements on the susceptibility decline correlated well with the measured linewidths. Two types of varactor diodes are being investigated for use in nonparametric-type limiters—PN and PIN. The PN diodes were tested in a limiter configuration at high-pulse powers using a 1-megawatt L-band radar. The incident burnout energy was found to be 87,000 ergs, which is about ten times greater than expected. The limiter yielded about 30 db of protection, did not have any spike leakage, and has an expected recovery time of about 0.05 μsec. Similar measurements of the PIN diodes yielded performance data that were inferior to the PN diodes, and the incident burnout energy was not much greater. The investigation of the applicability of Bosma's analysis to the design of a broadband circulator (low-field case) has been completed. The results were somewhat disappointing since the analysis does not appear capable of broadening the band by using conventional techniques. A comprehensive experimental and theoretical technique has been developed for symmetrically matching a circulator. A series of measurements of input impedance (as a function of pump power) were made on a nondegenerate C-band balanced parametric amplifier. These measurements are expected to yield enough information to choose the simplest varactor equivalent circuit capable of accurately predicting amplifier performance, and to yield a reference with which to compare future components.
Author

N63-13726 Temple U., Philadelphia, Pa.

VOLTAGE MEASUREMENTS IN THE PRESENCE OF STRONG FIELDS Scientific Report No. 1

K. G. Moses and T. Korneff Dec. 15, 1962 20 p 8 refs
(Contract AF 19(628)-215)
(AFCRL-63-216)

A description is given of an apparatus capable of measuring instantaneous voltages in the presence of heavy current discharges. The basic advantages of the system are: (1) a single ground connection which is independent of the two points of the desired voltage, (2) cancellation of induced voltages in measuring circuit by electronic means with band pass depending only upon amplifiers used; and (3) the cancellation of the measuring circuit pickup is insensitive to large changes in the geometry of the measuring circuit. Author

10 FACILITIES

Includes: airports; lunar and planetary bases; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands and wind tunnels); test ranges; and tracking stations.

For related information see: 06 Auxiliary Systems.

N63-13417 Office of Research Analyses. Science and Engineering Div., Holloman AFB, N. Mex.

ANALYSIS OF ADVANCED TRACK PERFORMANCE CHARACTERISTICS

Herman F. Borges Jan. 1963 36 p 5 refs
(ORA-63-1)

Velocity and acceleration profiles of rocket sleds on an advanced track were determined, based on existing and advanced rocket-engine and sled designs. Sled families with a unit thrust of 100,000 pounds, using propellants of different specific impulse, were postulated. Rocket assembly weight and payload weight were expressed in terms of thrust, and tank and structural weight in terms of propellant weight. The upper limit for rocket sleds using liquid oxygen and liquid hydrogen as propellants is about 5400 feet per second in ambient air density at one percent payload-to-thrust ratio. This speed will increase to about 8000 feet per second if the track is enclosed in an evacuated tube at about one-third of the ambient air density. To attain this performance, a track about 40 statute miles long is required. Author

N63-13439 Jet Propulsion Lab. Calif. Inst. of Tech., Pasadena

SPACE PROGRAMS SUMMARY NO. 37—19, VOLUME III FOR THE PERIOD NOVEMBER 1 TO DECEMBER 31, 1962: DEEP SPACE INSTRUMENTATION FACILITY

W. H. Pickering Jan. 31, 1963 60 p 3 refs
(NASA Contract NAS7-100)
(JPL Space Programs Summary 37-19, Vol. III) OTS: $5.60 ph, $2.00 mf

Successful tracking and receiving of telemetry data from Mariner 2 on its flight to Venus continued. New buildings have been constructed at Goldstone. Research has continued in the areas of low noise systems, planetary radar, ranging systems, ground antennas, antenna range, and diplexers. Supporting studies for the advanced antenna systems were continued in the areas of a computer program for calculating reflector deflection, RF transmission through porous reflector material, and dynamic resonant tests of the 85-ft. Az-El antenna. A.R.B.

N63-13456 Aro, Inc., Arnold Air Force Station, Tenn.

STRESS AND THERMAL ANALYSIS OF THE THROAT SECTIONS 50-INCH MACH 10-12 TUNNEL (C)

R. Sherman and J. P. Cook Arnold Engineering Development Center, Feb. 1963 53 p 9 refs
(Contract AF 40(600)-1000)
(AEDC-TDR-62-231)

The design analysis of the throat section for a large (50-inch-diameter test section), continuous flow, axisymmetric wind tunnel which is currently in operation at the AEDC is described. The maximum stagnation conditions are 2000 psia and 1450° F. Several problems that must be considered before design are cited, and possible means of solution are discussed. The "as-built" article, which in essence is simply a water-cooled liner housed in a pressure shell, is described, and a method, which allows reasonable selections of geometry and cooling requirements, outlined. This method is extended to enable forecast of temperature distribution and resultant stress along the throat section and is applied not only to the Mach 10 configuration but also to a proposed interchangeable counterpart that would permit aerodynamic testing at Mach 12. Maximum stagnation conditions therein would be 2400 psia and 1940°F. Author

N63-13567 Naval Air Material Center. Aeronautical Structures Lab., Philadelphia, Pa.

DESCRIPTION AND CAPABILITY OF ENVIRONMENTAL TEST FACILITIES AT THE AERONAUTICAL STRUCTURES LABORATORY

R. J. Molella Sept. 12, 1962 50 p 14 refs
(NAMC-ASL-1042)

The aeronautical Structures Laboratory (ASL) has environmental test facilities that can simulate the structural effects of temperature, structural loading, vibration, and acoustic noise. The power available for heating tests is 4,000 kv-a continuous and 8,000 kv-a for 3 minutes. This power is capable of heating areas from 25 to 1,000 square feet for respective heating rates of 200 to 5 Btu/ft^2-sec. Automatic control of this power for heating tests is accomplished by 64 channels of control equipment. Other equipment that can be automatically controlled includes a resonance-follower vibration system and a portable temperature chamber, which is capable of steady-state temperatures up to 1,200°F and which can be used with either the 5-million-pound or 0.6-million-pound testing machine. The acoustic-noise facility is a field site with a single jet engine and associated acoustic accessories. Author

N63-13611 Naval Ordnance Test Station, China Lake, Calif.
SKYTOP-2 VERTICAL STATIC FIRING AND ALTITUDE-SIMULATION FACILITY
W. F. Thorn Feb. 1963 65 p 12 refs
(NAVWEPS-8068; NOTS-TP-3074)

This report describes the design, installation, and checkout of the Naval Ordnance Test Station's Skytop-2 vertical static-firing and altitude-simulation facility. Included are data on the vertical truss/test-stand assembly and the rocket-exhaust diffuser used for altitude simulation. Calibration and performance data from four full-scale Polaris second-stage firings are presented. Author

N63-13627 Aerojet-General Nucleonics, San Ramon, Calif.
ARMY GAS-COOLED REACTOR SYSTEMS PROGRAM Semi-annual Progress Report, July 1 through December 31, 1962
Feb. 22, 1963 115 p 64 refs
(Contract AT(10-1)-880)
(IDO-28602)

The ML-1 powerplant produced electrical power for the first time on 21 September 1962. All objectives of the initial experiment were achieved. In general, plant performance was about as predicted with the exception that unanticipated high temperatures were observed in the upper tube sheet of the reactor calandria. This condition was subsequently attributed, in major part, to energy deposition in the tube sheet from hot-gas flow which bypassed the fuel element insulation through imperfect fuel element seats. The IB-8T-2 (ML-1 first core prototype) in-pile experiment was concluded on 7 October after more than 10,000 hours of satisfactory operation. Investigation of the cause of embrittlement in the IB-8T-1 in-pile test specimen continued without definite resolution of the phenomenon. Engineering work was completed, hardware procured, and disassembly and reassembly completed for the modification of the TCS-670 to improve performance and eliminate certain mechanical deficiencies. Engineering for the modification of the CSN-1 turbine compressor set to improve performance was completed. The assembly of the alternator and start motor was completed, and preliminary performance tests of the alternator were initiated. The performance specification of the ML-1A power plant was completed and submitted to the USAEC. Author

N63-13712 Cutler-Hammer, Inc. Airborne Instruments Lab., Deer Park, N.Y.
AIRPORT TERMINAL PLAN STUDY [JANUARY—DECEMBER 1961]
P. H. Stafford, C. A. Denzler, F. B. Pogust, D. L. Stafford, and M. A. Warskow Feb. 1962 180 p
(Contract FAA/RDS-136)
(Rept. 7601-5)

From analyses of the servicing operations of transport aircraft at terminals with a wide variety of concepts and facilities, general criteria were developed for functional planning of airport terminal buildings and related areas. The study did not cover floor space requirements or architectural design. Author

N63-13774 Argonne National Lab., Ill.
THE FACILITY 350 HELLIUM-ATMOSPHERE SYSTEM
R. M. Mayfield, W. G. Tope, and A. B. Shuck Dec. 1962 45 p 17 refs
(Contract W-31-109-eng-38)
(ANL-6489)

The helium atmosphere system in Argonne's Facility 350 is described in detail. The system is straightforward, employing drying and carbon towers for the removal of moisture, oxygen, and other impurities. The bulk of the 15,000 ft^3 of helium atmosphere is continuously recirculated at nearly atmospheric pressure. Purification is accomplished at 140 psig on a portion of the gas that is passed through the drying tower at room temperature and the carbon towers at -46° C (-50° F). The operation is continuous, requiring a minimum of maintenance and operational manpower. The helium atmosphere is supplied to the glove-boxes with impurity levels below 3,000 ppm (0.3%) nitrogen, 1,000 ppm (0.1%) oxygen, and 50 ppm moisture. Such purity levels prevent oxidation and combustion of the plutonium materials being processed. Experimental data concerning the adsorption of oxygen from helium by activated carbon over a range of temperature and pressure conditions are also reported. Author

11 FLUID MECHANICS

Includes: boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence.

For related information see: 02 Aerodynamics of Bodies, Combinations, and Internal Flow, 03 Aerodynamics of Wings and Control Surfaces; 13 Heat Transfer; and 24 Physics, Plasma.

N63-13339 Aerospace Corp. Aerodynamics and Propulsion Research Lab., El Segundo, Calif.
TEST TIME IN LOW PRESSURE SHOCK TUBES
Harold Mirels Dec. 27, 1962 73 p 18 refs
(Contract AF 04(695)-169)
(TDR-169(3230-12)TN-5; SSD-TDR-62-204)

The reduction of test time in low-pressure shock tubes, due to a laminar wall boundary layer, has been analytically investigated. In previous studies by Roshko and Hooker, the flow was considered in a contact surface fixed coordinate system. In the present study, it was assumed that the shock moves with uniform velocity, and the flow was investigated in a shock fixed coordinate system. Unlike the previous studies, the variation of free-stream conditions between the shock and contact surface was taken into account. It was found that β, a parameter defined by Roshko, is considerably larger than the estimates made by Roshko and Hooker except for very strong shocks. Since test time is proportional to β^{-2}, previous estimates of test time are too large, particularly for weak shocks. The present estimates for β appear to agree with existing experimental data to within about 10 percent for shock Mach numbers greater than 5. In other respects, the basic theory is in general agreement with the previous results of Roshko. Author

N63-13351 Aeronautical Research Council (Gt. Brit.)
THE BURSTING OF LEADING-EDGE VORTICES—SOME OBSERVATIONS AND DISCUSSION OF THE PHENOMENON
N. C. Lambourne and D. W. Bryer (National Physical Lab.) London, HMSO, 1962 37 p 20 refs
(ARC R&M-3282; previously issued as ARC-22775) Available from HMSO: 14s. 6d.

The term bursting refers to the structural change from a strong regular spiral motion to a weaker turbulent motion which can occur at some position along a vortex. Various observations of this phenomenon have been recorded during low-speed tunnel investigations of vortex flows generated from sharp, swept-back leading edges. These reveal a sudden deceleration of fluid along the vortex axis and expansion of the vortex around a stagnant core downstream of which the flow is turbulent; it is possible at very low stream velocity to see the axial flow, after deceleration, deflect and perform a regular whirling motion before turbulent breakdown. These features, together with the effects of bursting on oil-flow patterns and pressures at the wing surface, are illustrated and described. Brief reference is made to observations at transonic speeds. The burst is found to be sensitive to several factors; in particular, an increase of pressure gradient along the vortex seems conducive to the occurrence of a burst. It is suggested that a condition essential for the burst to occur is a low total pressure within the vortex core coupled with an adverse pressure gradient along the axis. When bursting occurs in the flow above a plain wing it is likely that the occurrence is related to the adverse pressure gradient associated with the existence of a trailing edge. Experiments described in Appendix I show that a similar type of phenomenon can occur in the flow in a vortex tube. Author

N63-13371 Swedish State Shipbuilding Experimental Tank, Göteborg

COMPARISON OF PROPELLER DESIGN TECHNIQUES

C. A. Johnsson 1963 46 p 24 refs Presented at the Fourth Symposium on Naval Hydrodynamics, Wash., D.C., Aug. 27-31, 1962 (*Its* Publ. 52)

Some propeller design methods, based on vortex theory, are discussed and compared. Using different combinations of lifting-line and lifting-surface theories, propellers for two nonoptimum loading cases have been designed. As a result of designs for one of the loading cases, model propellers have been manufactured and submitted to open-water and cavitation tunnel tests in homogeneous flow. The effective pitch and cavitation properties thus determined are compared with those theoretically predicted. In the cavitation tunnel, the axial component of the induced velocity behind the propeller has been measured at different radii and the values obtained compared with calculated values. For comparison, an optimum propeller has been designed, manufactured, and tested. Some of the conclusions drawn from the results are summarized. Author

N63-13376 David Taylor Model Basin. Hydromechanics Lab., Washington, D.C.

EXPERIMENTAL DETERMINATION OF THE FORCES ON SUPERCAVITATING HYDROFOILS WITH INTERNAL VENTILATION

N. L. Ficken, Jr., and G. F. Dobay Jan. 1963 25 p 5 refs (DTMB-1676)

An investigation is in progress at the Taylor Model Basin to develop techniques for using internal ventilation to produce very low cavitation numbers at low and moderate speeds. A nondimensional coefficient, the ventilation index K_v, has been defined. It has been found that the cavitation number based on measured cavity pressure behaves differently for ventilated flows at speeds in the supercavitating regime than at speeds in the subcavitating regime. In both cases, however, the measured cavitation number is related directly to the ventilation index and is relatively insensitive to angle-of-attack. At high values of the ventilation index (about 0.19 for tests of the 5-term foil reported here), the lift and drag coefficients become constant at values appropriate to zero cavitation number. Methods for relating the lift and drag coefficients for various ventilating airflow rates to the appropriate cavitation number are presented for the two speed ranges. Discrepancies exist between the results obtained from high- and low-speed ventilated tests. Author

N63-13380 Diamond Ordnance Fuze Labs., Washington, D.C.

PROCEEDINGS OF THE FLUID AMPLIFICATION SYMPOSIUM, VOLUME I, OCTOBER 2-4, 1962

Nov. 15, 1962 472 p refs

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30. A COMPARISON OF THE RELIABILITY OF ELECTRONIC COMPONENTS AND PURE FLUID AMPLIFIERS H. L. Fox (Sperry Utah Co.) p 455-469 6 refs (See N63-13409 08-11)

N63-13381 Diamond Ordnance Fuze Labs., Washington, D.C.
WALL EFFECT AND BINARY DEVICES
R. W. Warren *In its* Proc. of the Fluid Amplification Symp., Vol. I, Oct. 2-4, 1962 Nov. 15, 1962 p 11-20 (See N63-13380 08-11)

Discussion of a bistable fluid amplifier using entrainment characteristics of a large jet power stream and boundary walls to effect stream deflection includes: initial and final fluid flows between parallel walls; methods of switching the stream; control of completely filled bistable elements; a flow model for interaction and profile adjustment regions; memory characteristics which are functions of the divider within the element; adjustment of an overexpanded stream by means of an oblique shock wave; and the effects of increasing the parameter dimensions of a bistable element. I.v.L.

N63-13382 Diamond Ordnance Fuze Labs., Washington, D.C.
AN INTRODUCTION TO PROPORTIONAL FLUID CONTROL
Silas Katz *In its* Proc. of the Fluid Amplification Symp., Vol. I, Oct. 2-4, 1962 Nov. 15, 1962 p 21-26 (See N63-13380 08-11)

The development of a proportional fluid control system without mechanical moving parts is described. The system consists of an active component and passive components. The active component is the proportional fluid amplifier which provides a large fluid output signal that is proportional to a smaller fluid input signal. The passive components which produce their effects solely because of fluid properties and a particular geometry are: pressure, which is analogous to voltage; flow, which is analogous to current; resistance, the magnitude of which depends upon the viscosity of the fluid and the diameter of the orifice; inertance (inductance), the magnitude of which depends upon the length of the tubing and its cross-sectional area; and capacitance, which depends upon the volume of the tank. The function of these passive components is to operate on the signal waveform and to produce such effects as an output pressure which is approximately the integral of the input pressure by combining resistance and capacitance. Use of these components has lead to the development of an amplifier with measured pressure gains in the neighborhood of 500, by cascading several stages of amplification. The stages are directly coupled, i.e., the outputs of a stage are fed directely into the inputs of the succeeding stage. I.v.L.

N63-13384 Diamond Ordnance Fuze Labs., Washington, D.C.
THE HYDRAULIC ANALOGY
Ralph G. Barclay *In its* Proc. of the Fluid Amplification Symp., Vol. I, Oct. 2-4, 1962 Nov. 15, 1962 p 37-40 (See N63-13380 08-11)

The basic phenomena of fluid amplification in open-channel liquid flow were investigated, using the technique of hydraulic analogy which is the analogy existing between two-dimensional compressible-gas flow and open-channel liquid flow. This technique provides a means of flow visualization. Complex flows can be observed using models which are very easily made and very easily changed. In this way the effect of various shapes can be quickly ascertained in a qualitative manner. Visualization is aided by the fact that the speed of flow in the liquid is approximately a thousand times slower than the corresponding flow in the compressible gas; thus, transient flow conditions can be observed by the naked eye. Results indicate that the ratio of the specific heats for the "analog gas" was 2. These results were based on inviscid flow conditions for both gas and liquid, with only negligible vertical accelerations allowed in the liquid. I.v.L.

N63-13385 Diamond Ordnance Fuze Labs., Washington, D.C.
PULSE DURATION MODULATION
R. W. Warren *In its* Proc. of the Fluid Amplification Symp., Vol. I, Oct. 2-4, 1962 Nov. 15, 1962 p 41-45 (See N63-13380 08-11)

An all-fluid pulse-duration modulation system, which accepts fluid signals proportional to missile error, is described. The system consists of a feedback-type oscillator driving a buffer amplifier which, in turn, drives the output bistable amplifier. All of the output of the bistable amplifier issues out of one output at a time, either the left or the right, and can be used as a reaction jet for purposes of control. If the error of the missile is sensed with a gyro, an air jet from the gyro can be divided between two adjacent orifices when the missile is on course, and as it deviates from the true course the flow will be more to one orifice than to the other. This variation can be fed into the left and right control inputs of the pulse duration modulation system. The control inputs are connected to the capacitors on the bistable amplifier. As the control signal on one side increases, the control signal on the other side will decrease. I.v.L.

N63-13386 Diamond Ordnance Fuze Labs., Washington, D.C.
A THREE STAGE DIGITAL AMPLIFIER
Carl J. Campagnuolo *In its* Proc. of the Fluid Amplification Symp., Vol. I, Oct. 2-4, 1962 Nov. 15, 1962 p 47-72 (See N63-13380 08-11)

This paper describes digital pneumatic elements, cascaded so as to obtain a high power output which can be controlled by means of a stream containing 10^{-3} of the output flow; a system consisting of three units in a cascade is discussed. Author

N63-13387 Diamond Ordnance Fuze Labs., Washington, D.C.
ROCKET THRUST VECTORING
Allen B. Holmes *In its* Proc. of the Fluid Amplification Symp., Vol I, Oct. 2-4, 1962 Nov. 15, 1962 p 73-80 (See N63-13380 08-11)

An experimental program is being conducted at DOFL to investigate the characteristics of a supersonic fluid amplifier discharging air at high Mach numbers into the expansion cone of a rocket nozzle for thrust vector control. Preliminary static firings of a cold gas Mach 3.2 nozzle with fluid amplifier controls were made. Direct measurements were made of the amplifier input flow, induced lateral thrust, and switching levels. Author

N63-13388 Diamond Ordnance Fuze Labs., Washington, D.C.
A FLUID-AMPLIFIER ARTIFICIAL HEART PUMP
Timothy G. Barila and Daniel E. Nunn (Walter Reed Army Inst. of Research), Kenneth E. Woodward, George Mon, and Henrik H. Straub *In its* Proc. of the Fluid Amplification Symp., Vol. I, Oct. 2-4, 1962 Nov. 15, 1962 p 81-93 2 refs (See N63-13380 08-11)

Fluid amplification, a recent invention concerned with the control of flowing fluids without moving parts, has been applied to the powering and control of an extracorporeal heart pump. Except for an artificial ventricle, two artificial heart valves and a flapper to control suction, the fluid amplifier pump has neither moving control parts nor electronics. The output is pulsatile, and its average rate of flow varies directly with filling pressure and inversely with vascular

and other resistances, to achieve flow regulation. High reliability, long life, and low cost are achieved. Early evaluation tests suggest its performance capabilities and hemolytic characteristics are at least equal to those of the better available heart pumps. Author

N63-13389 Aerophysics Co., Washington, D.C.

SURVEY ON COANDA FLOW

Paul K. Chang (Catholic U. of America) *In* Diamond Ordnance Fuze Labs., Washington, D.C. Proc. of the Fluid Amplification Symp., Vol. I, Oct. 2-4, 1962 Nov. 15, 1962 p 95-108 31 refs (See N63-13380 08-11)

(Contract Nonr-2747(00))

A survey of 31 available references of analyses and experiments was made on Coanda flow which clings to a curved or deflected surface and increases mass rate-of-flow. This survey may be useful to better understand the mechanics of this type of flow and for its practical use of fluid amplification. Author

N63-13390 Diamond Ordnance Fuze Labs., Washington, D.C.

FLOW VISUALIZATION

Jorma R. Keto *In its* Proc. of the Fluid Amplification Symp., Vol. I, Oct. 2-4, 1962 Nov. 15, 1962 p 109-123 4 refs (See N63-13380 08-11)

Construction details are presented on two schlieren systems which have been used at DOFL, together with illustrated results of typical images obtained. A method of sealing interchangeable pure-fluid elements to optical windows, permitting repeated use without renewal of materials or contamination of windows, is given. Techniques for aiding visualization in difficult situations are discussed. Motion pictures are presented to illustrate the various schlieren techniques and the use of high-speed photography in the visualization of transient phenomena. Author

N63-13391 Minneapolis-Honeywell Regulator Co., Minn.

FLOW VISUALIZATION AND EXPERIMENTAL STUDIES OF A PROPORTIONAL FLUID AMPLIFIER

R. J. Reilly and J. A. Kallevig *In* Diamond Ordnance Fuze Labs., Washington, D.C. Proc. of the Fluid Amplification Symp., Vol. I, Oct. 2-4, 1962 Nov. 15, 1962 p 125-142 3 refs (See N63-13380 08-11)

Experimental data taken on a particular type of closed, proportional fluid amplifier did not agree with analysis based on two mathematical models. Visualization studies and detailed measurements in the interaction region of 3 fluid jets show that the power stream is accelerated after leaving the power nozzle. This fact is not predicted by either mathematical model. Author

N63-13392 Corning Glass Works, N.Y.

PRODUCTION OF FLUID AMPLIFIERS BY OPTICAL FABRICATION TECHNIQUES

R. W. Van Tilburg *In* Diamond Ordnance Fuze Labs., Washington, D.C. Proc. of the Fluid Amplification Symp., Vol. I, Oct. 2-4, 1962 Nov. 15, 1962 p 143-156 (See N63-13380 08-11)

A presentation is made of the results of a study of the applicability of optical fabrication techniques to the production of fluid amplifiers. Advantages and limitations of Fotoform materials as they are related to the fabrication of fluid systems are discussed, along with data relating process variables and performance. Results indicate that it is possible to fabricate the complex fluid amplifier designs rapidly and relatively inexpensively, and this can be done with a material which is dimensionally stable, capable of high-temperature operation, unaffected by nuclear radiation, and impervious to most corrosive liquids and gases. Author

N63-13393 Bowles Engineering Corp., Silver Spring, Md.

"OPTIFORM", OPTICAL MACHINING OF PURE FLUID SYSTEMS IN PLASTICS

Ronald E. Bowles and John R. Colston *In* Diamond Ordnance Fuze Labs., Washington, D.C. Proc. of the Fluid Amplification Symp., Vol. I, Oct. 2-4, 1962 Nov. 15, 1962 p 157-168 1 ref (See N63-13380 08-11)

Optiform is a low-cost, fast, production technique for machining constant-depth pure fluid systems in plastic. The optical machining is accomplished by using a master silhouette to define the areas of a conditioned sheet of plastic which are exposed to ultraviolet light and consequently polymerized. The unexposed areas remain soft and are washed away using a sodium hydroxide solution. From the standpoint of pure fluid systems, Optiform has limitations as to maximum temperature (150° F) and minimum size components which can be processed as a production-line product, i.e., with limited inspection. The basic circuit plate is assembled with a transfer plate and a manifold plate to provide a rugged package having a thick aluminum surface front and rear, and can be further protected by addition of an aluminum channel (like a picture frame) to protect the edges of the assembly where the plastic edge is exposed. Standard Clippard fittings tapped into the aluminum base plates provide an easy means for connecting the system inputs and outputs to auxiliary equipment. With Optiform and a file of silhouettes of components of known performance characteristics, one can assemble a pure fluid control system at the drawing board with high probability that the first of the resulting low-cost, short-lead-time production models will function properly. Author

N63-13395 United Aircraft Corp. Research Labs., East Hartford, Conn.

CHARACTERISTICS OF TWO-DIMENSIONAL COMPRESSIBLE ATTACHED JETS

R. E. Olson *In* Diamond Ordnance Fuze Labs., Washington, D.C. Proc. of the Fluid Amplification Symp., Vol. I, Oct. 2-4, 1962 Nov. 15, 1962 p 179-200 6 refs (See N63-13380 08-11)

Analytical and experimental studies of the characteristics of two-dimensional, compressible jets attached to an adjacent boundary wall were conducted with air as the working fluid. A theoretical flow model is presented, and methods for predicting the jet characteristics based on this model are discussed. Experimental measurements of the flow profiles within the jet at various axial stations both upstream and downstream of the reattachment location for Mach numbers of 0.90 and 2.0 are presented. Correlations of the experimental results on the basis of the analytical concepts are made for certain regions of the jet. Measurements of pressure-recovery characteristics of a diffuser located downstream of reattachment are presented and compared with pressure recoveries calculated on the basis of average conditions at the diffuser inlet. Author

N63-13396 Oklahoma U. School of Engineering, Norman

THE APPLICATION OF FREE JET MIXING THEORIES TO FLUID AMPLIFIER ELEMENTS

Glen W. Zumwalt *In* Diamond Ordnance Fuze Labs., Washington, D.C. Proc. of the Fluid Amplification Symp., Vol. I, Oct. 2-4, 1962 Nov. 15, 1962 p 201-216 21 refs (See N63-13380 08-11)

Korst's turbulent free-jet mixing theory and Chapman's laminar free-jet mixing theory were investigated in order to (1) make immediate application where possible, (2) delineate inherent limitations, and (3) suggest profitable extensions of the theoretical treatments. The investigation was limited to two-dimensional, perfect gas jet-flows, where the jet "core" is supersonic. Results indicate that the two jet mixing theories investigated can be applied immediately with confidence to many plane flow fluid amplifier problems. I.v.L.

N63-13397 Syracuse U., N. Y.

INTERACTION OF TRANSVERSELY IMPINGING JETS

Darshan S. Dosanjh and William J. Sheeran *In* Diamond Ordnance Fuze Labs., Washington, D. C. Proc. of the Fluid Amplification Symp., Vol. I, Oct. 2-4, 1962 Nov. 15, 1962 p 217-265 15 refs (N63-13380 08-11)

Experiments on the interaction of transversely impinging jet flows were performed in which a low-pressure control-jet flow interacted with a relatively high-pressure power-jet flow. The ratio of the control-jet to the power-jet supply-chamber gage stagnation pressure was varied. Both two-dimensional and axisymmetric jets were used. Shadowgraphs of the power jet alone as well as of the corresponding interacting jet flows were recorded to establish the nature of, and changes in, the shock structure. The two-dimensional jet flows were traversed by a pitot tube to record pitot pressure at various locations downstream of the power jet exit. It was observed that the impingement of only two percent control jet flow was sufficient to change the normal shock front of the highly underexpanded two-dimensional jet flow to a repetitive oblique shock structure. A considerable increase in the corresponding maximum pitot pressure downstream of the previous location of the normal shock was recorded. Possible importance of this phenomenon to fluid amplifiers using such highly underexpanded power-jet flows is pointed out. Author

N63-13398 United Aircraft Corp. Research Labs., East Hartford, Conn.

AN ANALYTICAL AND EXPERIMENTAL STUDY OF TWO-DIMENSIONAL COMPRESSIBLE SUBMERGED JETS

R. E. Olson *In* Diamond Ordnance Fuze Labs., Washington, D. C. Proc. of the Fluid Amplification Symp., Vol. I, Oct. 2-4, 1962 Nov. 15, 1962 p 267-286 3 refs (See N63-13380 08-11)

Analytical and experimental studies of compressible, two-dimensional, turbulent submerged jets were conducted with air as the working fluid. A theoretical flow model is presented and a momentum integral analysis is developed based on this flow model. The analysis employs constant exchange coefficient mixing theory to express the turbulent shear stress and assumes a Gaussian velocity distribution in the mixing zone. Relationships are presented for the length of the inviscid core and the centerline velocity decay in the fully developed portion of the jet in terms of an empirical shear stress constant. Experimental results obtained for jet Mach numbers between 0.66 and 2.0 are discussed and employed to evaluate the shear stress constant which appears in the analysis. These values of shear stress constant are correlated with jet Mach number, and the significance of this correlation is discussed. Author

N63-13399 California U., Los Angeles

CHARACTERISTICS AND CONTROL OF FREE LAMINAR JETS

Alan Powell *In* Diamond Ordnance Fuze Labs., Washington, D.C. Proc. of the Fluid Amplification Symp., Vol. I, Oct. 2-4, 1962 Nov. 15, 1962 p 289-299 7 refs (See N63-13380 08-11)

A description is presented of some relevant basic features of laminar incompressible jet flows as a separate element free of the effects of adjacent solid walls. The characteristics of the steady flow are well established, theoretically and experimentally. Results are given showing how the main jet is deflected by side jets, the deflection angle being dependent upon the geometry. Classical instability theory of periodically disturbed "psuedo-laminar" jets has been supplemented by recent experimental work which has disclosed that the frequency range for disturbance growth is real, spreading, laminar jets. This work is now extended to the case of the main jet being disturbed by periodic (modulated) side jets. The classical oscillatory feedback of edgetones, from a wedgelike obstruction lying in the jet back to the orifice, is discussed, as is also the case when a resonating element is in the feedback path. Author

N63-13400 Newark Controls Co., Bloomfield, N.J.

PNEUMATIC LINEAR CIRCUITS

Beatrice A. Hicks and Evelyn S. Jetter *In* Diamond Ordnance Fuze Labs., Washington, D.C. Proc. of the Fluid Amplification Symp., Vol. I, Oct. 2-4, 1962 Nov. 15, 1962 p 301-318 2 refs (See N63-13380 08-11)

Demonstrable analogies between pneumatic, electrical, and mechanical systems are applied to the same kinds of circuit theory so as to be able to predict the behavior of a given pneumatic system and to design for desired performance characteristics. The flow rate of gases in pneumatic circuits corresponds to current in electrical circuits or velocity in mechanical analysis. In a pneumatic circuit, which is in temperature equilibrium, flow rate is the number of cubic inches of gas passing a given point in one second when that gas is measured at unit pressure. Flow rate may vary with time and be an alternating flow just as current or velocity in electrical and mechanical systems may. The extension of the analysis to a pneumatic system, including inductance, will obviously result in more complex equations because it is necessary to consider difference in pressure, Δp, through the inductance as well as through the resistance of the orifice. J.R.C.

N63-13401 Diamond Ordnance Fuze Labs, Washington, D.C.

GAIN ANALYSIS OF THE PROPORTIONAL FLUID AMPLIFIER

S. J. Peprone, Silas Katz, and John M. Goto *In its* Proc. of the Fluid Amplification Symp., Vol. I, Oct. 2-4, 1962 Nov. 15, 1962 p 319-356 4 refs (See N63-13380 08-11)

A theoretical analysis was made of the gains in pressure, volume, flow, and power of a proportional amplifier; and predictions were compared with experimental data. An incompressible fluid was assumed in this analysis and the measurements were made using air at less than 5 psig. The theory indicates that a power gain of about 100 is easily achievable with pressure and flow gains of about 10. All gains are at maximum when the power stream is evenly divided by the two output apertures. The gains decrease with deflection angle and become zero when the stream is approximately centered in one of the apertures. The power gain maximizes at about 11 power-jet nozzle widths downstream with aperture widths 1.5 times the power-jet nozzle width. Comparison of those aspects of the theory that could be checked on a single laboratory model showed good agreement within the experimental error. On this model the pressure gain was calculated to be 9.1 and measured 8.4; the flow gain was calculated to be 10.5 and measured 9.4. J.R.C.

N63-13402 Fluid Logic Control Systems, New York, N.Y.

TURBULENCE AMPLIFIER DESIGN AND APPLICATION

Raymond N. Auger *In* Diamond Ordnance Fuze Labs., Washington, D.C. Proc. of the Fluid Amplification Symp., Vol. I, Oct. 2-4, 1962 Nov. 15, 1962 p 357-366 (See N63-13380 08-11)

The turbulence amplifier is a pneumatic or hydraulic no-moving-parts fluid amplifier with many unique properties which make it suitable for use in logic circuits and as a primary sensor of low velocity fluid streams and low acoustic waves. The turbulence amplifier produces signal amplification by the disturbance of a liminar flow in a submerged jet. The turbulence amplifier has a number of advantages when used as a switching element in logic circuits. It is a major convenience in constructing such circuits to use an element which is free of impedance-matching problems and which exhibits the large fan-out ratio (1:10) of these units. The complete isolation of turbulence amplifier inputs and the fact that a single amplifier can have an almost unlimited number of inputs is a major advantage in many practical circuits. A third major advantage of turbulence amplifiers is the fact that each amplifier performs the logical NOR function, which can be used as the basis for all of the other logic functions, such as AND, OR, MEMORY (flip-flop), and counting circuits. J.R.C.

N63-13403 Massachusetts Inst. of Tech., Cambridge

ON THE INHERENT LIMITATIONS IN FLUID-JET MODULATORS

F. T. Brown *In* Diamond Ordnance Fuze Labs., Washington, D.C. Proc. of the Fluid Amplification Symp., Vol. I, Oct. 2-4, 1962 Nov. 15, 1962 p 367-379 10 refs (See N63-13380 08-11)

The manner in which wave motion, energy dissipation, and gross jet turbulence produce inherent limitations in fluid-jet modulators is qualitatively discussed. Topics include surge impedance matching at input and load ports, the possibility of nearly infinite pressure and power gains of "momentum-controlled" and "pressure-controlled" jet amplifiers, and the effect of nozzle design on jet noise with implications on the signal-to-noise ratio and other operating conditions. Author

N63-13404 Johnson Service Co., Milwaukee, Wis.

PROPORTIONAL POWER STAGES FOR IMPEDANCE MATCHING PURE FLUID DEVICES

Thomas J. Lechner and Martin W. Wambsganss *In* Diamond Ordnance Fuze Labs., Washington, D.C. Proc. of the Fluid Amplification Symp., Vol. I, Oct. 2-4, 1962 Nov. 15, 1962 p 381-404 (See N63-13380 08-11)

A study is made of the proportional power stages for impedance-matching pure-fluid amplifiers of the three-dimensional type. This amplifier is based on the interaction of two streams: a supply (or power) stream and a signal (or control) stream. The principle of operation of such a pure fluid amplifier is a transfer of momentum at the point of intersection of the two streams. The equations presented representing the flow ratios are only approximate, but the results give direction and insight as to the compatibility of pure fluid devices. Even though restrictions were placed on the geometric parameters ($5 \leq G \leq 22$, $0.5 \leq R_s \leq 2.0$), these restrictions do not contradict the physically realizable range. If the equations for the flow ratios were improved, these realizable limits could be increased to cover almost any range that would be desired. J.R.C.

N63-13407 General Electric Co. General Engineering Lab., Schenectady, N. Y.

A SUGGESTED SYSTEM OF SCHEMATIC SYMBOLS FOR FLUID AMPLIFIER CIRCUITRY

W. A. Boothe and J. N. Shinn *In* Diamond Ordnance Fuze Labs., Washington, D. C. Proc. of the Fluid Amplification Symp., Vol. I, Oct. 2-4, 1962 Nov. 15, 1962 p 437-447 (See N63-13380 08-11)

This paper proposes a system of shorthand symbols that effectively differentiates between analog and digital devices, beam deflector and vortex amplifiers and passive versus active types of valves. A means of designating the memory and no-memory digital amplifier is also provided. On this simple base it is possible to build symbols representing the more sophisticated logic and control components. Examples given include an operational amplifier, simple flip-flop, counter, half adder (or exclusive OR), AND, OR, and NOT elements. Representation is also suggested for the commonly used circuit elements such as resistance, capacitance, and inductance. Some of the common pitfalls of electrical analogies to these elements are outlined. Examples of schematic circuits using these suggested symbols are also presented. Author

N63-13408 Bowles Engineering Corp., Silver Spring, Md.

A TECHNIQUE FOR MATCHING PURE FLUID COMPONENTS APPLIED TO THE DESIGN OF A SHIFT REGISTER

Edwin M. Dexter *In* Diamond Ordnance Fuze Lab., Washington, D.C. Proc. of the Fluid Amplification Symp., Vol. I, Oct. 2-4, 1962 Nov. 15, 1962 p 449-453 (See N63-13380 08-11)

An approximate method is described which has proven useful in evaluating the matching possibilities of units, quality control, and circuit testing of a pure fluid circuit. The basis for this technique is in approximating the steady-state control input admittance of elements with an equivalent orifice which performs in the manner of the hydraulics square law; $Q = KP^{1/2}$. It is shown that the admittance characteristics, Q^2/P, can be used to select elements to perform a desired function as well as to establish the expected performance of elements in a circuit during trouble-shooting. Tests for quality control purposes can also be made effectively with this method to check performance at specific operating conditions. J.R.C.

N63-13409 Sperry Utah Co., Salt Lake City

A COMPARISON OF THE RELIABILITY OF ELECTRONIC COMPONENTS AND PURE FLUID AMPLIFIERS

Harold L. Fox *In* Diamond Ordnance Fuze Labs., Washington, D.C. Proc. of the Fluid Amplification Symp., Vol. I, Oct. 2-4, 1962 Nov. 15, 1962 p 455-469 6 refs (See N63-13380 08-11)

Current achievements in attaining high reliability for electronic components are compared to the predicted reliability of pure fluid amplifiers. Figures for electronic components are presented for various environmental regimes which may be encountered in industrial, field, and aerospace applications. Due to the lack of statistical data on pure fluid devices, the predicted reliability results from certain assumptions. The assumptions are discussed. Reliability of pure fluid amplifiers under severe conditions of temperature, vibration, shock, and radiation is predicted. The results of the comparisons of the reliability of electronic components and pure fluid amplifiers are applied to a typical system problem. Predicted system failure rates are given for both electronic and fluid systems. Author

N63-13438 Oklahoma U. School of Engineering, Norman

HIGH-SPEED FLOW THROUGH POROUS MEDIA Interim Technical Report No. 1

Edward F. Blick and Eric Weger (Washington U., St. Louis) Jan. 1963 121 p 20 refs

(Contract DA-ORD-31-124-61G74)

(AROD-3005-4)

A new model called the capillary-orifice model for flow of fluids through a porous media is presented. A comparison between the capillary-orifice model theory and experimental data on pressure drop through porous media shows a close correlation. A computer program is developed to study the effects of temperature-dependant flow geometry on steady flow of a gas through porous media taking into account variable viscosity, viscous dissipation, and a first-order, temperature-dependent, irreversible catalytic reaction. An experimental and theoretical analysis is made of two interacting planar pressure waves. The waves are generated by application of pressure step functions to the opposite faces of a porous core. An unsteady-state computer program is developed to handle the associated nonlinear parabolic partial differential equations. Author

N63-13465 General Electric Co. Space Sciences Lab., Philadelphia, Pa.

CHEMICAL NON-EQUILIBRIUM EFFECTS IN HYPERSONIC PURE AIR WAKES

M. Lenard, M. E. Long, and K. S. Wan Dec. 1962 39 p 6 refs Presented at the American Rocket Soc. 17th Annual Meeting and Space Flight Exposition, Los Angeles, Nov. 13-18, 1962

(Contract AF 04(647)-617)

(R62SD989; ARS Paper 2675-62)

The effect of finite chemical reaction rates on the chemical structure of hypersonic wakes is examined. The technique of incipient nonequilibrium coefficients, based on linearized chemical kinetics for a seven-component ten-reaction model of high-temperature air, is utilized in the analysis. The far wake is treated as an asymptotic region; the near-wake theory considers the viscous mixing of the boundary-layer flow with the inviscid and recirculating flows in the base region, and the subsequent development of this viscous core into the wake region downstream. A range of altitudes and flight speeds of practical interest is considered. The results show where

the nonequilibrium effects are important in the wake and whether they arise primarily from convective or diffusive effects. The species that are the principal contributors to the nonequilibrium effects are also identified. The incipient nonequilibrium results are then related to calculations assuming chemically frozen flow. By the application of chemical kinetics to the frozen results, it can be shown that the appearance of incipient nonequilibrium effects bears an inverse relationship to the validity of the frozen-flow assumption for equivalent wake calculations. Author

N63-13478 General Applied Science Labs., Inc. Westbury, N.Y.
IMPROVED RATE CHEMISTRY PROGRAM FOR ONE-DIMENSIONAL INVISCID AIR FLOW WITH PRESCRIBED PRESSURE VARIATIONS
Martin H. Steiger Sept. 18, 1962 36 p 16 refs Prepared for MIT Lincoln Lab.
(Contract AF 19(604)-7400; ARPA Order 13)
(GASL-TR-246; LL-37-11)

The technique, initiated by Bloom and Steiger, for predicting the chemical behavior and the state of a flow field about a body traveling at hypersonic speeds is investigated. In particular, the representation of the chemical kinetics of air is made more complete. Pressure distributions, which are considered to be reasonable on the basis of idealized calculations or experiments, are prescribed along stream tubes. Thermochemistry calculations are carried out by utilizing the one-dimensional equations that govern the steady inviscid flow of a reacting gas mixture. The governing equations of the one-dimensional reacting system are considered under the *a priori* assumptions that all vibrational states are in equilibrium and that isoenergetic conditions prevail. J.R.C.

N63-13479 General Applied Science Labs., Inc., Westbury, N. Y.
IMPROVED HYPERSONIC LAMINAR WAKE CALCULATIONS INCLUDING RATE CHEMISTRY
Martin H. Steiger Sept. 18, 1962 33 p 6 refs Prepared for MIT Lincoln Lab.
(Contract AF 19(604)-7400; ARPA Order 13)
(GASL-TR-249; LL-37-12)

Improvements in the prediction of the properties of a laminar, axisymmetric, hypersonic wake which may not be in thermodynamic equilibrium include: (1) air chemistry rate processes involving seven species, i.e., O_2, O, N_2, N, NO, NO^+ and e^-; (2) the introduction of an additional parameter (Hnn_0) which couples the energy integral equation and boundary condition, thus permitting a simple evaluation of the effect of an initial defect in the stagnation enthalpy and/or Prandtl-Lewis numbers different from unity on the flow field; and (3) the programing of the system of equations on the IBM 7090 digital computer. This enables such advantages as automatic interval change, utilization of a Runge-Kutta scheme in the forward integration, test for maximum truncation error, evaluation of the temperature (which is given in terms of a transcendental algebraic expression) to any desirable accuracy and calculation of profiles in the physical plane at any predetermined axial stations. I.v.L.

N63-13483 General Applied Science Labs., Inc., Westbury, N.Y.
AN ESTIMATE OF THE EFFECTS OF A LAMINAR EQUILIBRIUM BOUNDARY
Antonio Ferri Sept. 18, 1962 20 p 6 refs Prepared for Lincoln Lab., MIT
(Contract AF 19(604)-4559)
(GASL-TR-182; LL-37-9)

The effect of a dissociated, laminar boundary layer upon the structure of the wake downstream of a reentering body (2½-inch-nose-radius body) was investigated to determine whether the effect of the layer may be significant for inclusion in the analysis of the chemical species of the wake. A simplified model of the flow field was assumed in which the dissociated and ionized air in the flow is considered separately as the boundary layer close to the body and an inviscid flow filling the balance of the field out to the shock. A constant γ approximation was used to compute the pressure distribution around the body so as to be able to obtain the outer edge boundary conditions. Pressure distributions for the unseparated laminar boundary layer at altitudes of 150,000 ft, 200,000 ft, and 250,000 ft were obtained. The electron density distribution about the body at these altitudes was determined as a function of temperature and pressure. Results of the investigation showed that the electron distribution in the flow field at the rear of the body can be satisfactorily represented without taking into account the presence of the boundary layer; this layer did not contribute significantly to departure from the electron density distribution in the inviscid field. Therefore, for the 2½-inch-nose-radius body considered, the contribution of the equilibrium laminar boundary layer to the dissociated ionized flow may be neglected in analysis of the chemical species of the wake. B.J.C.

N63-13493 Aberdeen Proving Ground. Ballistic Research Labs., Md.
CHARACTERISTIC CALCULATION OF NON-EQUILIBRIUM FLOWS
R. Sedney, J. C. South, and N. Gerber Apr. 1962 37 p 18 refs Presented at the AGARD meeting on High Temperature Effects on Hypersonic Flow, Apr. 3-6, 1962
(BRL-1173)

The problem of computing nonequilibrium flows by the method of characteristics is studied. It was found that the frozen characteristics could be used, even arbitrarily close to equilibrium. However, the standard difference technique was not successful in such a computation. A more accurate technique was developed; this technique is of second-order accuracy. The choice of dependent variables was important to the success of the computation. The results of computing flows over wedges with vibrational relaxation are given. It is found that far from the tip of the wedge the equilibrium state near the wedge is not uniform; the pressure is constant but the temperature is not. Thus an entropy layer exists at the wedge surface. Some approximate solutions for this flow are discussed. Author

N63-13502 Sandia Corp., Albuquerque, N. Mex.
A STUDY OF VELOCITY PROFILES IN THE MOMENTUM INTEGRAL METHOD WITH SLIP BOUNDARY CONDITIONS Research Report
K. J. Touryan Feb. 1963 16 p 8 refs
(Rept. SC-4752(RR)) OTS: $0.50

The Von-Karman Pohlhausen Momentum Integral method is extended to viscous flow problems with slip. The effect of the choice of velocity profiles and surface boundary conditions on displacement thickness is studied and some explanations presented. Author

N63-13521 University of Southern Calif. Engineering Center. Aerodynamic Test Lab., Point Mugu, Calif.
DESCRIPTION OF AN EXPERIMENTAL INVESTIGATION OF THE EFFECTS OF BOUNDARY LAYER BLEED ON SHOCK WAVE—BOUNDARY LAYER INTERACTION
John B. Wainwright Dec. 28, 1962 20 p 3 refs
(USCEC-65-35)

To establish engineering design criteria for supersonic air-induction systems, the effects of suction on shock wave-boundary layer interaction characteristics were investigated. Tests were made in the Aerodynamic Test Laboratory (ATL) wind tunnels. Pitot pressure profiles of the boundary layer were measured at locations considered to be upstream, within, and downstream of the shock wave-boundary layer interaction region. These measurements were made over the solid 20%- and 50%-porosity plates at nominal Mach numbers 2.3 and 3.0, and with the shock generator angle fixed at about 10° with

respect to the plate. The effects of from five to ten different combinations of forward and aft bleed were investigated for each plate. An investigation of the variation in pitot pressure profile within the interaction region was made over the 20%-porosity plate at Mach number 2.3 and at a relatively fixed shock strength (the shock angle ranged from 11.5 degrees to 13.8 degrees). Six combinations of bleed were investigated. Also, an attempt was made to determine minimum suction rates for the prevention of boundary layer separation at various shock strengths for five different plate configurations. The gross results from the test program, such as characteristic shock wave—boundary layer interaction lengths and boundary-layer thickness downstream of the interaction, can be applied to engineering problems, such as the designing of supersonic air-induction systems, provided that the general features of the porous plate configurations are duplicated with the same bleed rates relative to the local free-stream mass flow. B.J.C.

N63-13527 France. Office National d'Études et de Recherches Aéronautiques, Chatillon-sous-Bagneux

RECHERCHES SUR LA THÉORIE HYPERSONIQUE DES PETITES PERTURBATIONS [RESEARCH ON THE HYPERSONIC THEORY OF THE SMALL PERTURBATIONS]

Jean-Pierre Guiraud May 1962 134 p 50 refs In French; English abstract

(*Its* Publ. 107; ONERA-107(1962))

Following a general survey of the hypersonic theory of small perturbations and the investigation of a simple case, flows in the neighborhood of sectionally uniform flows, the supersonic flow around a convex profile is studied by a formal process of successive approximations. It is shown that the first stage of this process identifies itself with the expansion-shock method of Eggers and Syvertson. The solution presented for this first stage is complete but is expressed in finite terms and in a simple manner only within the scope of the hypersonic theory of small perturbations. The theory of small perturbations is used again for blunt bodies. It is shown that the bluntness effects, already observed experimentally, produce a fundamental modification of a flow structure such as is described by the theory of Hayes-van Dyke which is only valid in the case of a body with a perfectly sharp nose. The necessary modifications are described in a somewhat different form from those schematically described by the explosion theory. Author

N63-13528 France. Office National d'Études et de Recherches Aéronautiques, Chatillon-sous-Bagneux

FONCTIONS ABÉLIENNES D'UN GROUPE KLEIŃEEN. APPLICATIONS A L'AÉRODYNAMIQUE [ABELIAN FUNCTIONS OF A KLEINIAN GROUP. APPLICATIONS TO AERODYNAMICS]

Robert Legendre Nov. 1962 72 p 2 refs In French; English summary

(ONERA-109 (1962))

The potentials of flows around circular obstacles are first determined, and the fields obtained are examples of Abelian functions of real moduli in the plane of a Kleinean variable of uniformization. The Abelian functions of any modulus are defined and the series established for their calculation. The logarithm of the Theta-Abelian function is also determined by a series which accessorily provides an expression for the Riemann constants of the Kleinean group. Two applications of Abelian functions to aerodynamics are carried out as far as the explicit expression of the potential flow: one concerns slender bodies equipped with large sweepback multiple fins; the other aims at the evaluation of the effects of various modes of aerodynamic coupling in the case of vibrations of compressor blades and turbine buckets. Author

N63-13550 General Applied Science Labs., Inc., Westbury, N. Y.

PRELIMINARY ANALYSIS FOR THE VISCOUS SHOCK LAYER FLOW OVER BLUNT BODIES

Raymond Edelman Feb. 19, 1963 36 p 14 refs

(Contract NOrd-18053)

(GASL-TR-337)

Based on continuum theory, an approach is developed for computing the flow field in the viscous shock layer of a blunt body. The method employed is a multiple strip-multiple integral technique developed by Belotserkovskii for the inviscid blunt-body problem. The change in state through the shock includes the effects of viscosity, heat conductivity, and curvature. An arbitrary exponential viscosity-temperature relation is employed in the shock layer. The present analysis uses a two-strip approximation and is assumed to retain the basic features of the flow field valid up to altitudes of approximately 300,000 feet and flight velocities below the limit of approximately 50,000 feet/sec., where direct coupling between radiation and flow dynamics becomes important. Author

N63-13624 Harry Diamond Labs., Washington, D.C.

FLUID AMPLIFICATION. 5. JET ATTACHMENT DISTANCE AS A FUNCTION OF ADJACENT WALL OFFSET AND ANGLE

Sheldon G. Levin and Francis M. Manion Dec. 31, 1962 32 p 6 refs

(TR-1087)

Attachment of a submerged, incompressible, two-dimensional, turbulent jet to an adjacent straight wall (Coanda effect) is analyzed. Parametric equations are developed that predict the point at which the jet attaches as a function of wall angle and offset distance. Computer solutions were obtained for several sets of conditions. Experiments were conducted with both air and water jets at Mach 0.5 equivalent, and results agree well with corresponding computer solutions when the jet spread parameter is also treated as a function of offset distance and wall angle. The equations provide an analytic method, independent of the particular fluid, for predicting the attachment distance, and should be helpful in designing elements based on the Coanda effect, e.g., the fluid flip-flops or bistable elements. Author

N63-13657 Aro, Inc., Arnold Air Force Station, Tenn.

VIBRATIONAL NONEQUILIBRIUM WITH NITROGEN IN LOW-DENSITY FLOW

Alexander D. Lewis and George D. Arney, Jr. Arnold Engineering Development Center, Mar. 1963 31 p 13 refs

(Contract AF 40(600)-1000)

(AEDC-TDR-63-31)

This analysis shows the approximate effect of lagging vibrational adjustment on the flow properties in low-density, nitrogen flow through hypersonic nozzles. Results show that for equipment and conditions typical of low density, high-enthalpy wind tunnels, significant amounts of the total energy of the gas may be frozen in the vibrational mode downstream of the nozzle throat. This portion of the total energy is not available to participate in the flow process. In one case, with a total temperature of 3000° K, the vibrational energy essentially frozen downstream of the nozzle throat is approximately 10 percent of the test section total enthalpy, whereas the vibrational energy component at the test section would amount to only 0.05 percent if equilibrium were maintained. A shock process caused by placing a blunt body in the test section was found to cause release of a negligible portion of the vibrational energy. This result is attributed to the long relaxation length compared to stand-off distance. Author

N63-13658 Aro, Inc., Arnold Air Force Station, Tenn.

VISCOUS EFFECTS ON ZERO-LIFT DRAG OF SLENDER BLUNT CONES

Jack D. Whitfield and B. J. Griffith Arnold Engineering Development Center, Mar. 1963 46 p 24 refs
(Contract AF 40(600)-1000)
(AEDC-TDR-63-35)

Experimental drag data from a series of cone models are presented over a wide range of Reynolds numbers at hypersonic flow conditions. The data include Mach numbers from 9 to 22, with Reynolds numbers based on model length ranging from 600 to 500,000. Most data were obtained with test-model surface temperature cold relative to the stagnation temperature; a limited amount of hot-wall data was obtained. Theoretical estimates based on existing theories are given, and the significant contributions to the zero-lift, viscous drag rise of cold-wall cones are identified as the usual "similar" or Blasius friction drag and transverse curvature effects. The theoretical estimates are shown to offer a good engineering approximation to the hypersonic viscous drag of cold-wall, blunt slender cones within the continuum flow regime. Author

N63-13680 Iowa Inst. of Hydraulic Research, Iowa City

FORCE ON A PROLATE SPHEROID IN AN AXISYMMETRIC POTENTIAL FLOW

L. Landweber and Matilde Macagno Feb. 1963 37 p 18 refs
(Contract Nonr-1611(01))

Exact and linearized expressions for the image system and the force on a prolate spheroid in an axisymmetric flow are derived and applied to the case of the flow about a spheroid due to an external source on the axis of symmetry. The results obtained are not valid when the source is closer to the spheroid than a certain critical distance, such as in the case of nearly spherical spheroids. The image system for the case of nearly spherical spheroids is found to consist of a source and doublet at the origin; a source and doublet at the inverse point of the location of the external source; and distributions of sources and doublets extending along the axis from the center of the spheroid to the inverse point. B.J.C.

12 GEOPHYSICS

Includes: auroral phenomena; upper atmospheric studies; cartography; geodesy; and geomagnetism.

For Van Allen belts see: 28 Space Radiation.

For related information see: 05 Astronomy and Astrophysics; 21 Meteorology; and 29 Space Sciences.

N63-13329 Texas Instruments, Inc., Dallas

TERRAIN QUANTIFICATION. PHASE I: SURFACE GEOMETRY MEASUREMENTS Final Report

Donald D. Carr and Jack R. Van Lopik Dec. 31, 1962 128 p 348 refs
(Contract AF 19(628)-481)
(AFCRL-63-208)

As a preliminary step in the development of militarily significant methods of terrain quantification, the status of surface-geometry research was briefly reviewed. Presently used surface-geometry measurements were grossly evaluated for potential military usefulness on the basis of their universality of application, degree of complexity, repeatability, completeness, and mappability. Those measurements or properties which rated high in the evaluation were studied in greater detail. Although microrelief is an integral part of surface geometry, its description and classification involves unique problems demanding special consideration. Several aspects of the application of autocorrelation and spectral-analysis techniques to the description of microrelief profiles were examined. The status of the description and classification of ground, vegetation, hydrographic and cultural factors was briefly considered. An annotated bibliography, including 348 entries, was compiled and indexed according to terrain-factor groups. Problem areas were identified and recommendations made for continuing research. Author

N63-13350 Polish Academy of Sciences. Committee on Geodesy, Warsaw

RECHERCHES SCIENTIFIQUES SUR L'UTILISATION DES SATELLITES ARTIFICIELS DE LA TERRE DANS LA GÉODÉSIE [SCIENTIFIC RESEARCH ON THE USE OF ARTIFICIAL EARTH SATELLITES IN GEODESY]

L. Cichowicz 1962 4 p Presented at the Symposium on the Use of Artificial Satellites for Geodesy, Washington, D.C., U.S. Naval Observatory, Apr. 26-28, 1962 In French

Problem areas studied in connection with the use of artificial satellites in geodesy are: (1) using artificial satellite observations to study the shape of the earth; (2) using artificial satellites and rockets in determining length of the geodetic line; (3) determining the geodetic line and the transfer coordinates and the azimuth in three-dimensional space; (4) comparing three methods for determining the shape of the earth: gravimetric, geometric, and one based on observations of artificial satellites; and (5) applying cartometry in solving problems involved in determining the orbits and positions of artificial satellites. Trans. by A.R.B.

N63-13482 Wilmot Castle Co., Rochester, N. Y.

STERILIZATION OF SPACE PROBE COMPONENTS. Final Report, April 19, 1961 - July 31, 1962

Martin G. Koesterer [1962] 83 p 6 refs
(NASA Contract NASr-31)
OTS: $8.10 ph, $2.69 mf

The studies reported have attempted to define the various biological, chemical, and physical factors that could influence the effectiveness of dry-heat as a sterilizing process. A list of the areas of investigation follows: (1) the screening, isolation, and growth of organisms resistant to dry heat; (2) the effects of time, temperature, strain of microorganism, and concentration on the effectiveness of dry-heat sterilization; (3) the effect of the physical carrier (paper strip, glass tube, sand, and vermiculite) on the effectiveness of dry-heat sterilization; (4) the effects of air, vacuum, inert gases, entrapment of organisms in nonaqueous liquid and on solids; (5) methods for sterility testing of components after inoculation with spores of known resistance to dry heat and the subsequent application of adequate sterilization cycles. Findings to date are as follows: (1) Mesophilic aerobic spore-formers are, in general, more resistant to dry heat than are the anaerobic and thermophilic spore-forming bacteria. (2) The type of carrier markedly affects the dose requirements for dry-heat sterilization. Soil samples are the most resistant, with sand, vermiculite, glass, and paper following in that order. (3) The gaseous environment also markedly influences the time required for sterilization. Samples in air are the most resistant with samples under helium and under low vacuum (10^{-1}–10^{-2} mm Hg) being less resistant, respectively. (4) Entrapment of dry bacterial spores in solids definitely increases the dose of dry heat required for sterilization. (5) These data raise a question concerning the adequacy of the proposed 24-hour dry-heat cycle at a temperature of 125° C. Author

N63-13524 Rensselaer Polytechnic Inst., Troy, N. Y.

ULTRASONIC OBSERVATION OF THE CALCITE-ARAGONITE TRANSITION

Thomas J. Ahrens and Samuel Katz Repr. from J. Geophys. Research, v. 68, no. 2, Jan. 15, 1963 p 529-537 21 refs
(NASA Grant NsG-100-60; Grants NSF-6-5240, and NSF-6-9374)

Elastic-wave velocities were measured as a function of pressure by ultrasonic pulse interferometry in Solenhofen and Manlius limestone specimens to pressures of 27 and 38 kb. Longitudinal velocities decrease sharply from 5.3 km/sec at a mean pressure of 4 kb to a minimum of 4.8 km/sec at 8 kb. Transverse velocities decrease from 3.1 to 2.9 km/sec. At the minimum, bulk and rigidity moduli are 25 and 10 percent below their 4-kb values. A density increase of 1.7 percent is associated with this minimum. The observed effects are attributed to the calcite-aragonite transition, and they may be due to an inherent property of the material, a major component of which undergoes a polymorphic transition, the low- and high-pressure phases coexisting over a considerable pressure range. This may be an additional mechanism to account for low-velocity zones in the earth's interior. Author

N63-13600 Cornell U. Center for Radiophysics and Space Research, Ithaca, N. Y.

ON MAGNETOSPHERIC INTERCHANGE INSTABILITY

B. U. Ö. Sonnerup and M. J. Laird Repr. from J. Geophys. Research, v. 68, no. 1, Jan. 1963 p 131-139 7 refs
(NASA Grant NsG-184-60)

It has been pointed out that the gas in the magnetosphere of the earth can take part in large-scale motions in which tubes of force of equal flux and the gas within them are interchanged. Such motions leave the magnetic field and its energy almost unchanged, and may therefore be driven by variation in the state of the gas. The stability of the magnetosphere against such motion occurring spontaneously is studied by investigation of the change in potential energy of the system during a hypothetical interchange of two tubes of force. For isothermal interchanges, the energy criterion may be cast into a useful form without further physical assumptions. Our analysis shows that, except possibly at low latitudes, such motions are not of importance. The more realistic case of adiabatic interchanges is discussed in the two limits where the gravitational energy is much smaller or much larger, in absolute value, than the internal energy of the gas. Smaller gravitational energy applies to the outer tubes of force for which the energy content is dominated by the internal energy of the fully ionized hot gas residing far out in the geomagnetic field; spontaneous interchanges occur only if the energy content of the tubes of force decreases sufficiently rapidly in the outward direction. Larger gravitational energy applies to the inner tubes of force since the energy content of these tubes is dominated by the gravitational energy of the cold gas at the feet of the tubes of force, i.e., the ionospheric material. It is shown that spontaneous adiabatic interchanges may occur if the temperature in the upper ionosphere increases sufficiently rapidly with increasing latitude. It is also demonstrated that the temperature gradients in subauroral latidues, caused by the heating of the ionosphere in the auroral zones by fast particles, may be sufficient to trigger this instability. Thus an inner convective zone may exist in the magnetosphere. The size and location of this zone are discussed. Author

N63-13686 Weizmann Inst. of Science, Rehovoth (Israel)

STUDIES IN TERRESTRIAL SPECTROSCOPY Technical Note 5

C. L. Pekeris, Z. Alterman, and H. Jarosch Jan. 3, 1963 44 p 13 refs
(Contract AF 61(052)-509)
(AFCRL-63-261)

The effect of the rigidity of the inner core on the free oscillations of the earth, made for model Bullen B, was extended to the Gutenberg model. It was found that the Gutenberg model also has a "core" oscillation but of longer period, which, however, decreases rapidly with the rigidity μ of the inner core, reaching the observed value of 53.9 minutes for $n = 2$ at $\mu = \frac{7}{32} \times 10^{12}$ dyne/cm^2. At this value of μ, as well as at the corresponding value of $\mu = \frac{1}{2} \times 10^{12}$ dyne/cm^2 for model Bullen B, the core oscillation has become transformed into a regular type oscillation. In addition to the fundamental core oscillation, both models have "inner core" oscillations in which the energy is confined mainly to the inner core. For the purpose of identifying the 86-minute gravitationally recorded oscillation, we have investigated the relative excitation of the regular and core oscillations by both a P-source and an SV-source situated near the surface. While the period could be fitted for $n = 2$ at $\mu \simeq 0.1 \times 10^{12}$ dyne/cm^2, the amplitude at the surface was found to be smaller by a factor of 100 than that of the regular oscillations. The spheroidal oscillations of order $n = 1$ were then investigated. Here again the surface amplitude of the mode excited by a near-surface source remains small until the core oscillation is transformed into a regular type and the period correspondingly reduced. The regular spheroidal mode for $n = 1$ has a period of 40.7 minutes for the Gutenberg model and of 41.7 minutes for the Bullen B model. At the surface, the displacement is nearly horizontal, to within 10%, and the gravitational perturbation is also smaller than in the case $n = 2$. It is suggested that the 42.3-minute oscillation observed on the Isabella strain seismometer may be due to an $n = 1$ spheroidal oscillation rather than an $n = 2$ torsional oscillation. Author

N63-13688 Kiruna Geophysical Observatory (Sweden)

AURORAL ZONE SATELLITE SCINTILLATION STUDIES Scientific Report No. 4

Ludwik Liszka July 10, 1962 10 p 9 refs
(Contract AF 61(052)-601)
(AFCRL-62-1054)

Satellite scintillation studies carried out at Kiruna Geophysical Observatory on frequencies 20 and 54 Mc/s during the last three years, are reviewed. Studies of correlation of the occurrence of scintillations with ionospheric data show that at least an important part of fast satellite scintillation observed in the auroral zone is produced by auroral sporadic E layers. Author

N63-13710 University Coll., London (Gt. Brit.)

RESEARCH ON EFFECTS OF ELECTRON COLLISIONS IN ATMOSPHERIC GASES Technical Report

R. W. Lunt Feb. 14, 1962 50 p
(Contract AF 61(052)-110)
(AFCRL-62-1077)

Absolute rate coefficients have been measured for the emission of radiation in the spectral ranges above and below 2000 A from low-pressure uniform-field d.c. discharges of very low current density in hydrogen, nitrogen, and oxygen in the field-to-pressure range 20 to 120 volts cm^{-1} mm Hg^{-1}. The rate coefficients are given in photons per cm of electron drift motion and per unit gas pressure. Approximate cross sections have been derived for the principal electron-impact reactions with ground state molecules generating the excited species to which the radiation is attributed. Author

N63-13711 Queen's U., Belfast (N. Ireland)

THE HYDROXYL BANDS IN THE NIGHTGLOW

A. F. Ferguson and D. Parkinson [1962] 28 p 19 refs
(AF Grant EOAR 62-118)
(AFCRL-63-239)

The standard method for determining the relative transition probabilities of vibrational-rotational bands from experimental data is examined. It is shown that the relative intensities in the high-overtone sequences are likely to be similar to those for a linear dipole moment, and that it is impossible to predict either the dipole moment or the intensities in sequences with lower Δv values from them. When this is taken into account the method is found to be satisfactory in its application to synthetic data derived from a model moment. Procedures for determining the signs of ratios of transition integrals based on experimental data are noted. Author

N63-13719 National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

NOTE ON THE THICKNESS OF THE HELIUM ION LAYER

S. J. Bauer Washington, NASA, Mar. 1963 7 p 18 refs
(NASA TN D-1686) OTS: $0.50

On the basis of recent experimental results as well as theoretical considerations of the temperature dependence of the light constituents (hydrogen and helium) in the upper atmosphere, a model of the helium ion belt—the heliosphere—is constructed. The thickness of the helium ion layer varies significantly with atmospheric temperature: about 2000 km at 1600° K and only about 200 km at 600° K. Correspondingly, charged particle profiles in the topside ionosphere may show a slope corresponding to He^+ at high temperature, but not at low temperatures when the thickness of the helium ion layer is comparable to or less than the scale height of helium ions. Author

N63-13720 National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
PRELIMINARY MEASUREMENTS OF TEMPERATURES AND WINDS ABOVE 50KM OVER WALLOPS ISLAND, VIRGINIA
William Nordberg and Wendell Smith Washington, NASA, Mar. 1963 15 p 19 refs
(NASA TN D-1694) OTS: $0.50

Seventeen successful rocket grenade experiments were conducted at Wallops Island, Va. (38°N lat.), during the period July 1960 to June 1962. The purpose of these soundings was to describe further the atmosphere above 40 km within the framework of a previous analysis based on the IGY results at high and low latitudes. The soundings were distributed through all seasons; some were conducted in conjunction with sodium release (above 80 km) and small meteorological-rocket experiments (below 50 km). Preliminary results from the first ten grenade soundings are presented here. Comparison of grenade with sodium results shows an abrupt change in the physical nature of the circulation pattern between 70 and 80 km. Below this altitude, the previously described seasonal circulation pattern exists while above it no regular seasonal variations can be detected. The most characteristic phenomenon for this region is the very narrow jet-stream-like band of wind at the 100-km level combined with extremely high wind shears. The temperature structure at Wallops Island indicates the same mesospheric heating in wintertime as has been observed at Churchill. During periods of undisturbed easterly circulation, summer temperature profiles at Wallops Island exhibit the same features as typical low-latitude profiles previously observed. When the easterly circulation becomes disturbed, the temperature profile becomes very similar to previously observed summertime profiles at Churchill. During wintertime, the atmosphere over Wallops Island still lies within the region of a strong cyclonic vortex. Author

N63-13746 Republic Aviation Corp., Farmingdale, N. Y.
REFRACTION CORRECTION OF SHORT NAVIGATIONAL DISTANCES BY MEASURING ANGLE-OF-ARRIVAL
Frederick L. Ryder Jan. 25, 1963 4 p 4 refs
(RAC-1155)

Refraction correction of short navigational distances by measuring the angle-of-arrival is discussed in the light of obtaining information on some average value for the index of refraction along the line of sight by adding direction-finding equipment to the basic time-measuring equipment normally used for obtaining distance. I.v.L.

N63-13747 Republic Aviation Corp., Farmingdale, N.Y.
REFRACTION CORRECTION OF SHORT NAVIGATIONAL DISTANCES BY MEASURING ATTENUATION
Frederick L. Ryder Feb. 1, 1963 4 p 3 refs
(RAC-1163)

The use of vacuum-attenuation, oxygen-attenuation, and water-vapor-attenuation measurements is discussed in the light of improving the correction for the overall effect of refraction along a line of sight from a ground transmitter to an aircraft. I.v.L.

N63-13748 Republic Aviation Corp., Farmingdale, N.Y.
DIRECT MEASUREMENT OF INDEX OF REFRACTION
Frederick L. Ryder Jan. 31, 1963 2 p 5 refs
(RAC-1168)

Direct measurement of the index of refraction for sonde-borne use is reviewed in the light of meeting the required accuracy of the associated frequency shift measurement. This accuracy is about 2 parts per million over a range of about 300 parts per million. I.v.L.

N63-13760 Weapons Research Establishment (Australia)
IONOSPHERIC DATA FOR DECEMBER 1961 FROM WOOMERA, SOUTH AUSTRALIA
Oct. 1962 24 p
(Ionospheric Data Bulletin CPD 1961 / 12(W))

Tables of the hourly values of the customary ionospheric parameters are given for the station at Woomera for December 1961. Author

N63-13783 Academy of Sciences (USSR). Commission on the Study of the Sun, Moscow
HYDROGEN RADIATION IN THE SPECTRUM OF POLAR AURORAE (O VODORODNOM IZLUCHENII V SPEKTRE POLIARNYKH SIIANII)
S. I. Isaev *In its* The Physics of Solar Corpuscular Streams and Their Influence on the Upper Atmosphere of the Earth [1957] p 126-129
(See N63-13775 08-29)

Spectroscopic studies have been made of polar aurorae in the visible region. Preliminary analysis of the spectrograms gives grounds for assuming that hydrogen atoms (protons) enter the region in large numbers, but when the charge associated with the advance of protons becomes large in the E-layer, a vertical discharge occurs which is manifested as radial forms. At this time, hydrogen cannot be detected because of masking by the nitrogen bands. As soon as the vertical discharge ceases, hydrogen is once more detected. Hydrogen appears very clearly in the photographs of diffuse arcs and shifts toward the violet due to the Doppler effect. These results are consistent with those obtained by K. L. Bowles' radio observations of polar aurorae. R.C.M.

13 HEAT TRANSFER

Includes: ablation; cooling; heating; and other thermal effects.

For aerothermodynamics see: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; and 03 Aerodynamics of Wings and Control Surfaces.

For combustion see: 26 Propellants and Combustion.

For related information see: 11 Fluid Mechanics.

N63-13418 Office of Research Analyses, Holloman AFB, N. Mex.
A STUDY OF RADIANT HEAT TRANSFER IN A LUNAR SIMULATION CHAMBER
Maurice W. Wilden (New Mexico U.) Jan. 1963 87 p 11 refs
(ORA-63-2)

The thermal behavior of a vertical cylinder, representing a space capsule resting on the surface of the moon, was investigated in the environment of a lunar simulation chamber by use of an analytical network method. The parameters affecting radiative heat exchange between the ceiling of the chamber, the floor of the simulator, and

the cylinder were varied in the wide range of temperatures encountered during lunar day and night. The mathematical foundations of the analytical network method are explained, and the results displayed in diagrams. Author

N63-13425 Aro, Inc., Arnold Air Force Station, Tenn.
SOLUTION FOR THE TRANSIENT ONE-DIMENSIONAL HEAT CONDUCTION IN AN INFINITE SLAB
John T. Miller Arnold Engineering Development Center, Mar. 1963 18 p 4 refs
(Contract AF 40(600)-1000)
(AEDC-TDR-63-43)

A solution is presented for the transient temperature distribution through an infinite, homogeneous slab with a constant initial temperature and an insulated back face. The solution is obtained on the basis of an assumption that the insulated face temperature history is known and can be expressed as a sum of complementary error functions. This boundary condition can be replaced by either the temperature history at another station or, alternately, the temperature distribution at some time later than initial. The method is equally appropriate for cooling and heating. An advantage of this solution is that it requires only a knowledge of insulated face temperature history and imposes no restriction on the heat flux as a function of time. Author

N63-13441 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
DEVELOPMENT OF STABLE TEMPERATURE CONTROL SURFACES FOR SPACECRAFT Progress Report No. 1
W. F. Carroll Nov. 20, 1962 21 p 10 refs
(NASA Contract NAS7-100)
(JPL-TR-32-340) OTS: $2.60 ph, $0.83 mf

Several white paints and nonpaint "white" systems were tested in an experimental program for suitability as temperature-control surfaces in space with high-intensity ultraviolet radiation (approximately 10 × solar) in vacuum. The materials and methods of testing are presented along with a discussion of the measurement results. Of the materials tested, only zinc sulfide pigmented silicone paint and aluminized FEP Teflon retained adequate solar reflectance to be useful for periods of several months of solar exposure in space. Author

N63-13464 General Electric Co. Space Science Lab., Philadelphia, Pa.
THE KINETICS OF THERMAL DEGRADATION OF CHARRING PLASTICS. I: GLASS REINFORCED PHENOLFORMALDEHYDE Technical Information Series
Henry L. Friedman Aug. 1961 33 p 10 refs
(Contract AF 04(647)-269)
(R61SD145)

A technique was devised for obtaining rate laws and kinetic parameters which describe the thermal degradation of plastics from thermogravimetric-analysis data. The method is based on the intercomparison of experiments which were performed at different linear rates of temperature rise. The method was applied to a fiberglass reinforced phenolformaldehyde resin. The kinetic equation that was thus derived was checked by a variety of techniques, including a comparison with constant-temperature data that were available in the literature. The tests indicated that the equation was applicable to a major part of the degradation process. Author

N63-13474 Stanford U., Calif.
THERMA BUCKLING OF ANNULAR PLATES
Julio J. Fernandez-Sintes, Wilfred H. Horton, and Nicholas J. Hoff Dec. 1962 69 p 7 refs
(Grant AF-AFOSR-62-146)
(SUDAER-143)

Investigations of the thermal induced instability of annular plates in those cases where the temperature variation is symmetric about the axis of the plate and where the temperature is assumed to be uniform across the thickness of the plate include: (1) the determination of the radial temperature distribution corresponding to prescribed boundary conditions; (2) a method for obtaining approximate solutions for the theoretical determination of the occurrence of instability for a given plate and a given tranient temperature; (3) a description of the tests performed in the gathering of data on temperature and deflections; and (4) the use of this data in determining the critical temperature by means of a Southwell plot. I.v.L.

N63-13500 Atomic Energy Commission. Div. of Technical Information, Washington, D.C.
REACTOR HOT CHANNEL FACTORS AND BURNOUT A Literature Search
James M. Jacobs, comp. Nov. 1962 26 p 184 refs
(TID-3574) OTS: $0.50

This literature search covers heat transfer properties of fuel elements and cooling-water channels used in pressurized water power reactors. The reports are grouped by the corporate author. R.C.M.

N63-13520 National Beryllia Corp., Haskell, N. J.
RESEARCH ON LOW DENSITY THERMAL INSULATION MATERIALS FOR USE ABOVE 3000° F Third Quarterly Status Report for the Period October 1 to December 31, 1962
Karsten H. Styhr, Jr., Philip S. Hessinger, and Eugene Ryshkewitch [1962] 32 p 5 refs
(NASA Contract NASr-99)
OTS: $3.60 ph, $1.16 mf

Thermal conductivity measurements by a radial heat-flow method on several types of ceramics to temperature of 3250° F are reported and are consistent with data on similar materials from other laboratories. Data in the 2000° F to 3250° F temperature range on two zirconia specimens of widely different densities show a factor of ten greater increase in high-temperature conductivity of the foam over the increase in conductivity of the more dense zirconia. Several methods of incorporating radiation barrier materials such as carbon and hollow spheres of refractory metals into foams of stabilized zirconia and pure magnesia are described and discussed. Author

N63-13564 California U., Livermore. Lawrence Radiation Lab.
DOWNFLOW BOILING OF n-BUTANOL IN A UNIFORMLY HEATED TUBE
Graham F. Somerville (M.S. Thesis) Oct. 29, 1962 107 p 36 refs
(Contract W-7405-eng-48)
(UCRL-10527) OTS: $2.25

Local heat-transfer coefficients and two-phase total-pressure drops were measured for the forced-convection boiling of n-butanol in electrically heated tubes having an inside diameter of .4670 in. and heated lengths of 5.69 and 4.10 ft, respectively. Heat fluxes ranged from 2.8×10^4 to 6.6×10^4 Btu/h-ft^2 and mass fluxes from 136 to 440 lbm/sec ft^2. Exit qualities up to 31% were obtained at pressures between 16.9 and 50.0 psia. Measured heat-transfer coefficients ranged between 2,000 and 10,000 Btu/h-ft^2-°F. The boiling heat-transfer data were compared with previous correlations that had been based on the water-steam system. A new boiling heat-transfer correlation was derived having the form

$$St = 0.9005\, Re_l^{-0.286} X_{tt}^{-0.292} Bo^{0.191} Pr_l^{-0.233},$$

it was successful in correlating data for both water and n-butanol to within ±30%. Local two-phase total-pressure gradients ranging up to 8 psi/ft have been successfully correlated by the method of Schrock and Grossman. Local two-phase frictional-pressure gradients have been obtained and compared with previous results for the water-steam system. Author

N63-13629 Naval Propellant Plant, Indian Head, Md.
TEMPERATURE MEASUREMENTS AND HEAT TRANSFER CALCULATIONS IN ROCKET NOZZLE THROATS AND EXIT CONES
J. Nanigian Dec. 31, 1962 32 p 1 ref
(Tech. Rept. 122; NavWeps-8022)

Instrumentation techniques are described to record instantaneous temperature measurements in the throat and exit cone regions of rocket nozzles. Techniques are also described to calculate heat transfer in the nozzle throat and to study the char and erosion phenomena in insulating materials in nozzles. Temperature distribution curves in the nozzle insulation material are presented together with the char position, velocity, and depth as functions of rocket motor burning time. The use of thermocouples for measuring the gas-stream separation in over-expanded nozzles is described.
Author

N63-13636 Naval Radiological Defense Lab., San Francisco, Calif.
THERMAL DIFFUSIVITY MEASUREMENTS ON METALS AND CERAMICS AT HIGH TEMPERATURES [Final] Report [January 1, 1961 to January 1, 1962]
R. L. Rudkin, W. J. Parker, and R. J. Jenkins Wright-Patterson AFB, Ohio, Directorate of Materials and Processes, Jan. 1963 26 p 5 refs
(Contract AF 33(616)-61-7)
(ASD-TDR-62-24)

The adaption of the NRDL flash method to the measurement of the thermal diffusivity of metals and ceramics at high temperatures is described. A high intensity, short duration light pulse from a xenon flash lamp is absorbed in the front surface of a thermally insulated specimen a few millimeters thick, and the resultant temperature history of the rear surface is measured by a lead-sulfide-cell radiation detector or a thermocouple, displayed on an oscilloscope and photographed by a Polaroid Land camera. The thermal diffusivity of the material is determined from this temperature versus time curve, provided the theoretical boundary conditions are experimentally satisfied. Measurements of the thermal diffusivity of Armco iron, molybdenum, titanium, zirconia, and alumina have been made up to 1200° C, 1300° C, 1700° C, 1100° C and 1100° C, respectively.
Author

14 HUMAN BEHAVIOR

Includes: crew training and evaluation; piloting; psychological factors.

For simulators see: 10 Facilities.

For related information see: 16 Life Sciences.

N63-13420 Burroughs Corp., Paoli, Pa.
DESIGN OF A PAIRED-ASSOCIATES TRAINER FOR TRAINING RESEARCH [Final] Technical Documentary Report [Oct. 1960-Dec. 1961]
G. Lund, R. Hallman, R. La Monaca, J. Port, C. Questa, G. Rozran, Kirk A. Johnson, and John A. Modrick Wright-Patterson AFB, Ohio, Behavioral Sciences Lab., Nov. 1962 112 p
(Contract AF 33(616)-8071)
(AMRL-TDR-62-104) OTS: $2.50

Paired-associates learning is the association of a pair of terms in such a way that when one term is presented, the other term is elicited or selected. The stimulus terms are presented one at a time to a student who responds by recalling the response terms or by selecting them from a list. A study program was initiated to develop a device to present training materials, which are reducible to a paired-associates format, to a student until a specified level of mastery is reached. The Paired Associated Trainer (PAT) was designed as a research vehicle for a study program concerned with general-purpose, military, paired-associates-training devices. Complete information, including logic, circuit, and mechanical design, is given herein for a basic trainer. Features of a proposed expanded trainer and alternate trainer designs are presented, together with cost estimates on both the basic and the advanced trainer.
Author

N63-13451 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
GENERAL THEORY OF PERSONNEL DECISION
J. S. Brady Jan. 15, 1963 20 p 16 refs
(NASA Contract NAS7-100)
(JPL-TR-32-391) OTS: $1.60 ph, $0.80 mf

A general theoretical description of the human decision process is deduced from the input-output characteristics of the human as a tracking operator. The basic function, derived from Bayes' theorem of inverse probability, isolates the input and "expectancy" characteristics of the decision process. The relationships between the inferred implicit processes and measurable input characteristics are derived, and conformity of the general theory with experimental findings is explored.
Author

15 INSTRUMENTATION

Includes: design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gauges; and sensors and transducers.

For related information see: 06 Auxiliary Systems; 08 Communications; 09 Electronics; and 22 Navigation and Guidance.

N63-13369 National Aeronautical Corp., Ft. Washington, Pa.
DERIVATION AND INSTRUMENTATION OF GROUND SPEED INFORMATION FROM DME
A. R. Applegarth *In* Radio Technical Commission for Aeronautics, Wash., D.C. Minutes of Fall 1962 Assembly Meeting, Marriott Motor Hotel and the Naval Research Lab., Wash., D.C., Nov. 27-29, 1962 Dec. 5, 1962 2 p (See N63-13356 08-01)
(Paper 182-62/AS-254)

Problems in deriving speed information from electronic-ranging distance-measuring equipment (DME) are discussed: one problem concerns the small magnitude of the speed signal to be derived; the other relates to separating the desired speed signal from the spurious speed signals which can be considerably stronger than the true speed signal.
B.J.C.

N63-13394 Bowles Engineering Corp., Silver Spring, Md.
INSTRUMENTATION FOR RESEARCH AND DEVELOPMENT IN PURE FLUID SYSTEMS
Ronald L. Humphrey Eric E. Metzger *In* Diamond Ordance Fuze Labs., Washington, D. C. Proc. of the Fluid Amplification Symp. Vol. I, Oct. 2-4, 1962 Nov. 15, 1962 p 169-177 (See N63-13380 08-11)

Specific instruments for flow and pressure measurements in pure fluid systems are: (1) a thermistor anemometer, which is a visual indicator for quickly checking a large number of flow passageways; (2) a hot wire anemometer, which is an indicator used in conjunction

with an oscilloscope for displaying pneumatic waveforms; (3) a miniducer, which is a miniature piezoelectric pressure sensor for use in small channels; and (4) a fiber optics monitor, which is a system consisting of four channels containing light guides, photomultipliers, and amplifiers. This monitor combines high response with small sensors for the study of transients of density in the air flowing through pure fluid elements or systems and is used cooperatively with shadowgraph, schlieren, or inteferometer. I.v.L.

N63-13413 Army Missile Command. Guidance and Control Lab., Redstone Arsenal, Ala.

ANALYSIS OF AN AIR SUPPORTED PENDULOUS NORTH-SEEKING GYRO

James V. Johnston Jan. 4, 1963 22 p
(RG-TR-63-1)

The dynamic analysis is presented of an air-supported, pendulous, north-seeking gyro. Given are the complete three-dimensional equations, and their derivations, of motion of the gyro. Also presented is the mathematical comparison between a damped or static system and an undamped or dynamic system. The mechanization of an air-supported system and the advantages over other types of suspension systems are investigated. The air-supported, pendulous, north-seeking gyro was found to be a superior instrument in accuracy, weight, and size to present-day pendulous north-seeking gyros. Author

N63-13424 Aro, Inc., Arnold Air Force Station, Tenn.

THE DESIGN AND DYNAMIC CALIBRATION OF A PRESSURE TRANSDUCER SYSTEM FOR UNSTEADY PRESSURE MEASUREMENTS

R. F. Austin and G. C. Trail, Jr. Arnold Engineering Development Center, Mar. 1963 38 p 9 refs
(Contract AF 40(600)-1000)
(AEDC-TDR-63-29)

A specialized method is discussed for adapting conventional flush-mounted pressure transducers for measurement of unsteady pressures to 1000 cps. Details of the calibration apparatus are presented together with the measured effects of transducer-system geometry and environmental pressure level on the dynamic response of the system. Author

N63-13428 General Electric Co. Flight Propulsion Lab. Dept., Cincinnati, Ohio

SECOND ANNUAL REPORT—HIGH-TEMPERATURE MATERIALS AND REACTOR COMPONENT DEVELOPMENT PROGRAMS. VOL. III—REACTOR COMPONENT DEVELOPMENT

Feb. 28, 1963 63 p
(Contract AT(40-1)-2847)
(GEMP-177C) OTS: $1.50

This report is one of three volumes of the second annual report on the GE-NMPO high-temperature materials and reactor component development programs. This volume covers the work in process on reactor component development during calendar year 1962. There are eight specific development programs reported: (1) circulating ball reactivity control with capability of operating around sharp bends; (2) static switching utilizing solid-state devices; (3) capacitance temperature sensor based on the change in dielectric constant of alumina or beryllia versus temperature change; (4) high-temperature extension of conventional nuclear sensors (fission counters and d.c. ionization chambers); (5) development of nuclear sensors for monitoring and controlling high-temperature, high-performance reactors; (6) high-temperature fasteners involving stress relaxation of Inconel bolts and nuts up to 600°C (7) fasteners for remote maintenance; and (8) Monte Carlo program for nuclear analysis of complex reactor and shield systems. Significant results achieved on these programs are as follows: (1) A scram actuator employing three electromagnetic units, a straight guide tube, and a segmented rod capable of operating around bends demonstrated scram performance competitive with spring scram actuators. (2) A five-channel safety scram bus occupying a volume 5 × 6 × 3.5 inches was tripped 90,000 times in a period of 770 hours without a failure or sign of circuit deterioration. (3) The determination of temperature by sensing the change in dielectric constant of ceramic materials was established as a method capable of good sensitivity and resolution by testing up to 3000°F. (4) The feasibility of using a charged fragment detector without external power being applied to the detector to detect thermal neutrons was demonstrated. The problems associated with the use of Inconel X screw type fasteners at temperatures up to 1100°F were defined but not resolved. Author

N63-13459 Bureau of Mines. Norris Metallurgy Research Labs., Tenn.

A REPLICA ELECTRON MICROSCOPIC METHOD FOR MEASURING KNOOP HARDNESS INDENTATIONS

Charles W. Huggins and C. W. Houck Washington, Bureau of Mines, 1963 19 p 6 refs
(BM-RI-6181)

Knoop hardness indentations were studied and measured with the electron microscope on TiB_2, HfC, and AlB_{12} crystals. A detailed description of replicating the indentations using collodion and Faxfilm is made. A Johns Hopkins grating having 28,800 lines per inch was used to accurately determine the magnification used on the electron microscope. The primary objectives were to prepare carbon replicas of hardness indentations, to measure the indentations accurately, and to compare the results with those obtained with the light microscope. The resulting data showed excellent agreement between the measurements made on the replicas with the electron microscope and those made with the optical microscope. The replicas made from collodion showed slightly better agreement with the light optical values than did the replicas made from Faxfilm. Author

N63-13460 Massachusetts Inst. of Tech. Lab. for Insulation Research, Cambridge

DESIGN OF A QUADRUPOLE MASS SPECTROMETER

C. E. Woodward and C. K. Crawford Jan. 1963 32 p 9 refs
(Contracts AF 33(616)-8353 and Nonr-1841(10))
(MIT-TR-176)

A mass spectrometer using an electric-quadrupole mass filter has been designed and built to cover 1 to 400 amu in four ranges. The rf drive voltages for the quadrupole filter are obtained from a class c amplifier with feedback-controlled modulation. The d.c. voltages are obtained from feedback-controlled amplifiers. Provisions are made for rapidly sweeping the mass range by changing the rf and d.c. voltages and for oscillographic presentation of the spectra. It is found that a suitable relation between applied rf and d.c. voltages can make spectral line widths and filter transmission independent of mass. The spectrometer is found to have a maximum resolution of about 700; maximum resolution at unity transmission is about 30. The lowest pressure it can detect at present is about 10^{-10} torr. There is a fine structure on the peaks of the mass spectrum that is dependent upon the transverse momentum of the ions entering the quadrupole. Author

N63-13549 Atomics International, Canoga Park, Calif.

THERMAL PROPERTIES OF REFRACTORY MATERIALS (Second Quarterly Progress Report) [Dec. 1, 1962-Feb. 15, 1963]

R. E. Taylor and M. M. Nakata Feb. 1963 22 p 9 refs
(Contract AF 33(657)-7136; ARPA Order 24-62, Amend. 57)

The current status of the development of the transient thermal-property apparatus is described. As the result of a systematic analysis of the apparatus, several improvements are being made to improve the quality of the data. An investigation of alternate detectors for the recording pyrometer, to permit data collection at temperatures far below the 1200° C minimum imposed by the photomultiplier tube, is underway. This will permit tripling the present range of

useful operation. Progress has been made in extending the upper temperature limit of 1850° to 2500° C. The status of thermal property measurements by existing techniques is also included. Information on titanium nitride is presented. Author

N63-13575 California U., Livermore. Lawrence Radiation Lab.
TORY II-C INSTRUMENTATION—PART 6 OF THE TORY II-C PROGRAM
T. C. Varljen and G. St. Leger-Barter Jan. 1, 1963 37 p
(Contract W-7405-eng-48)
(UCRL-7036, Pt. 6) AEC: $0.75

The instrumentation system for use in the Tory II-C Program is described. The parameters monitored by the system include those for control of the reactor and air delivery system and for the acquisition of basic performance data. A major requirement imposed on the system is flexibility over extreme test conditions. Automatic data reduction capability is incorporated in the system to ensure rapid evaluation of test results. R.C.M.

N63-13578 National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ULTRAVIOLET PHOTODETECTORS
L. Dunkelman [1962] Repr. from J. Quant. Spectr. Radiative Transfer (London) v. 2 p 533-544 43 refs

The need for detectors in spectroscopic research in both the laboratory and in space has led to the development of a variety of spectrally selective detectors which may be put in two broad categories: (1) photoionization chambers having relatively narrow bandpasses within the region of 1050 Å to approximately 1500 Å; (2) multiplier phototubes having high work-function photocathodes falling into three major groupings which restrict the sensitivity to regions below approximately 3000 Å, 2000 Å or 1000 Å. This paper reviews the characteristics of vacuum u.v. ion chambers having fill gases such as nitric oxide, acetone, carbon disulfide or ethylene oxide with windows of LiF, CaF_2 or BaF_2. Their quantum yields range from approximately 10 to 50 percent and may be operated in gas multiplication mode with gains of 10^3 at 600 to 800 v. The characteristics of photomultipliers and phototubes having alkali telluride, copper iodide, or other cathodes with lithium fluoride, sapphire, quartz, or no window are described. Some of the photomultipliers studied have quantum efficiences as high as 30 percent, exhibit long wavelength rejection ratios of many orders of magnitude over only several hundred Å. The discussion of u.v. photodetectors is mostly confined to work that has been done either at the Goddard Space Flight Center or in association with it in connection with astrophysical and geophysical research. Author

N63-13593 California U., Riverside
FIELD EMISSION SPECTROMETER Technical Report No. 5
Allan M. Russell Repr. from Rev. Sci. Instr., v. 33, no. 12, Dec. 1962 p 1324-1327 18 refs
(Contract Nonr-1842(02))

An apparatus is described which measures the energy distribution of electrons extracted from solids, particularly semiconductors, by high electric fields. The energy spectra of these electrons are directly related to the location of allowed electronic states at the surface of the solid. Investigation of a range of energies and direct output of the energy spectra are obtained through the use of modulation and phase sensitive detection. Details of the spectrometer are described, including samples of the output spectra. Author

N63-13603 Massachusetts Inst. of Tech. Electronic Systems Lab., Cambridge
A VIBRATORY ACOUSTIC GYROSCOPE
Richard Swerdlow and John G. Whitman, Jr. Dec. 1963 29 p 8 refs
(NASA Grant NsG-149-61)
(ESL-TM-162; DSR-8836) OTS: $2.60 ph, $1.07 mf

A vibratory output angular motion sensing instrument utilizing the Coriolis mechanism was investigated. The principles of acoustic resonance in a high quality-factor fluid sensing system were applied to the problem of amplifying a low level coupling pressure signal and sensing it with the state-of-the-art pressure transducers. Loss mechanisms, determining the pressure amplification which can be obtained in the fluid resonator, are discussed, and a thermal noise analysis is presented which yields an expression for the thermal noise-equivalent angular rate input. Expressions derived for noise pressure, thermal threshold rate, and sensitivity are felt to be more significant for their analytical form than for the quantitative figures which they yield upon insertion of selected fluid parameters and apparatus dimensions. I.v.L.

N63-13604 Massachusetts Inst. of Tech. Electronic Systems Lab., Cambridge
CAPACITIVE TRANSDUCERS FOR NARROW-BAND VIBRATORY DISPLACEMENTS
John G. Whitman, Jr. Oct. 1962 40 p 17 refs
(NASA Grant NsG-149-61)
(ESL-R-15) OTS: $3.60 ph, $1.40 mf

A sensitivity figure of merit for an electromechanical transducer is shown to be the energy density in its coupling field, and the special case of the parallel plate capacitive transducer is analyzed in detail. The limitations on the figure of merit for this transducer are calculated using the Paschen's law curve for the breakdown potential difference of an air gap and it is shown that the maximum attainable energy density in a uniform electric field is on the order of 4.4×10^5 ergs/cm^3 under conditions which can be maintained in a transducer application. A comparison of this figure with the energy densities used in existing high-sensitivity capacitive transducers shows that present designs fall short of their ultimate capabilities by approximately a factor of 25, and that their performance can be improved by close to this factor by either evacuating or pressuring the sensor package. The characteristics of electrical discharges in the region to the left of the minimum in the Paschen's law curve are discussed, and a capacitor plate design is proposed which will allow transducers to be operated in this region. An experimental program confirmed the main features of the theoretical analysis despite experimental difficulties encountered in determining accurate breakdown potentials in the region to the left of the minimum. Author

N63-13609 Naval Research Lab., Washington, D.C.
THE U.S. NAVAL RESEARCH LABORATORY'S TRANSDUCER MEASUREMENT PLATFORM ON SENECA LAKE
H. L. Saxton and H. E. Eney *In its* Report of NRL Progress Feb. 1963 p 5-11 (See N63-13607 08-01) OTS: $1.25

The U.S. Naval Research Laboratory has established a mobile transducer measurement platform at Dresden on Seneca Lake, N.Y. The platform can handle 8000 cubic feet (20 x 20 x 20) of equipment weighing up to 40 tons, move such a load through 180 degrees from the bow to a point on the main deck 52 feet aft of the bow, and lower such load to a depth of 600 feet at the centerline off the bow, or at 90 degrees off the starboard side. In the deck house are three high-power amplifiers (1 kw, 10 kw, 240 kw pulsed or 175 kw continuous), a main power-distributing board, the usual oscilloscopes, signal generators, counters, etc., office area, and a comfort station. Below deck are diesel generators, tanks for diesel fuel and fresh water, and ballast tanks for controlling list when necessary. Author

N63-13625 Naval Ordnance Lab., Corona, Calif.
PROPERTIES OF PHOTODETECTORS. PHOTODETECTOR SERIES, 56TH REPORT
A. B. Naugle, W. L. Eisenman, and J. D. Merriam Feb. 1, 1963 31 p 1 ref
(NOLC-578)

Results are presented of measurements made on 12 photodetectors. Included are data sheets on indium antimonide cells, thermistor bolometers, and mercury-doped germanium cells. Author

N63-13640 Barnes Engineering Co., Stamford, Conn.
INFRA-RED AND ELECTRO-OPTICS. TEST AND EVALUATION OF AN ULTRA-VIOLET OBJECTIVE SPECTROGRAPH
W. A. Parrilla Jan. 10, 1962 19 p
(NASA Contract NAS5-1897)
(BEC-4674) OTS: $1.60 ph, $0.80 mf

The following is a report of the procedures involved in the fabrication, testing and evaluation of an ultraviolet objective spectrograph for the NASA Mercury program. Author

N63-13704 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
ASTRONAUTICS INFORMATION. MEASUREMENT OF GAMMA RADIATION
Dorothy Sweitzer, comp. Mar. 1, 1961 37 p 166 refs
(NASA Contract NASw-6)
(JPL-AI/LS-205) OTS: $3.60 ph, $1.31 mf

An annotated bibliography, covering material on detection and measurement of gamma radiation, is presented. Also, an author index is provided. B.J.C.

N63-13727 Federal Aviation Agency. Systems Research and Development Service, Atlantic City, N.J.
EVALUATION OF GENERAL AVIATION TRANSPONDERS Interim Report
R. H. Boutillette, R. W. Delaney, and W. Herget Nov. 1962 65 p 2 refs

Acceptance and flight tests were conducted at the National Aviation Facilities Experimental Center (NAFEC) on General Aviation Transponders (GAT). The acceptance tests consisted of bench tests, and flight tests were conducted to determine maximum operational range of these GAT equipments at several flight altitudes, up to 15,500 feet, compatibility of the equipments with the Air Traffic Control Radar Beacon System (ATCRBS), and appearance of their return signal on Plan Position Indicator (PPI) displays. Results of tests conducted thus far indicate that all equipments performed in accordance with the contract specifications. In addition, the transponders satisfactorily performed to a maximum range closely approximating radio line-of-sight and were compatible with the ATCRBS. Author

16 LIFE SCIENCES

Includes: biology; exobiology; physiology; medicine; life support systems; radiation effects on biological systems; and space sickness.

For related information see: 14 Human Behavior; and 28 Space Radiation.

N63-13342 Institute of Andean Biology, Lima (Peru)
MYOGLOBIN CONTENT AND ENZYMATIC ACTIVITY OF HUMAN SKELETAL MUSCLE—THEIR RELATION WITH THE PROCESS OF ADAPTATION TO HIGH ALTITUDE
Nov. 1962 Brooks AFB, Tex., School of Aerospace Medicine, 12 p 14 refs
(Contract AF 41(657)-249)
(SAM-TDR-62-89)

Quantitative determinations of myoglobin were made in the sartorius muscle of healthy human subjects, natives of sea-level and high-altitude areas. The specific activity of the reduced form of diphosphopyridine nucleotide oxidase (DPNH-oxidase), DPNH- and TPNH-cytochrome C reductases, transhydrogenase, and isocitric and lactic dehydrogenases were also examined. A significantly higher myoglobin concentration was found in the muscle of the high-altitude natives as compared with sea-level residents. The enzyme systems DPNH-oxidase, TPNH-cytochrome C reductase, and transhydrogenase similarly showed a significantly higher activity in altitude residents. It was concluded that the respiratory capacity of the muscle was apparently higher in natives living at high altitudes than in those living at sea level. The enchanced enzymatic activity was probably related to the higher pigment content of the skeletal muscle. Results on myoglobin determinations in several other muscles from certain sea-level patients are discussed. Author

N63-13421 Aerospace Medical Div. Aeromedical Research Labs. (6570th), Wright-Patterson AFB, Ohio
ONE-MINUTE TOLERANCE IN MAN TO VERTICAL SINUSOIDAL VIBRATION IN THE SITTING POSITION Final Report
Morris J. Mandel and Richard D. Lowry Oct. 1962 10 p 1 ref
(AMRL-TDR-62-121) OTS: $0.50

One-minute subjective tolerance in man to sinusoidal vertical vibration was determined in the sitting position. In comparing the data to previously published information, we noted that, although the new levels were higher, the contour of the curve remained unchanged. The reasons for this difference, as well as specific subjective complaints leading to tolerance, are presented and discussed. Author

N63-13440 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
STERILIZATION OF UNMANNED PLANETARY AND LUNAR SPACE VEHICLES—AN ENGINEERING EXAMINATION
L. D. Jaffe Jan. 7, 1963 23 p 40 refs
(NASA Contract NAS7-100)
(JPL-TR-32-325) OTS: $2.60 ph, $0.89 mf

The probability of achieving and maintaining sterility of an unmanned spacecraft with various proposed procedures is examined in detail. The required degree of assurance against infection of a planet with Earth organisms is also considered. For Mars landers and orbiters, sterilization by dry heat, with no subsequent access to the spacecraft, is found to be desirable. Glove-box sterile assembly is not recommended for these missions; sterile assembly in a hood or in the open seem wholly unsatisfactory. For Venus landers and orbiters, sterilization standards can be somewhat relaxed; for the Moon, sterilization appears unnecessary, but microbial counts should be kept low. Sterilization lowers spacecraft and system reliability. It reduces the chance of launching within periods fixed by astronomical constraints, and increases costs. Author

N63-13538 Aerospace Medical Div. School of Aerospace Medicine, Brooks AFB, Tex.
THE DETECTION OF IN-FLIGHT HYPERVENTILATION BY BLOOD AND URINE ANALYSES
James P. Ellis, Jr., and J. Gordon Wells Nov. 1962 10 p 11 refs
(SAM-TDR-62-117)

An alternate method for the detection of in-flight hyperventilation in pilots was investigated. The method is based on the measurement of several acid-base related components in blood and urine, and is more convenient and practical than the previously described method based on the measurement of P_{ACO_2} in end-expired air samples collected during flight. The data indicated that when a relatively small degree of hyperventilation is experienced by pilots, as indicated by the in-flight P_{ACO_2}, the corresponding small change

in blood and urine components is insignificant. When the in-flight PA_{CO_2} indicates a greater degree of hyperventilation, however, blood and urinary variables are significantly changed. It is concluded that the method can detect hyperventilation at a level of concern. Author

N63-13554 Aerospace Information Div., Library of Congress, Washington, D.C.
BACTERIAL SPECIES HARMFUL TO PETROLEUM PRODUCTS IN STORAGE
Feb. 21, 1963 5 p 7 refs
(AID-S-63-26)

A brief report on Soviet investigations of bacterial species that may possibly be damaging agents of stored petroleum products is presented. The discussion is based on literature dealing with detection and identification of (1) hydrocarbon-oxidizing bacteria, (2) sulfate-reducing bacteria, and (3) sulfide-oxidizing bacteria. Author

N63-13573 Naval Radiological Defense Lab., San Francisco, Calif.
SODIUM DEPENDENCE OF BIOELECTRIC OUTPUTS IN RAT STOMACH
J. T. Cummins and B. E. Vaughan Jan. 14, 1963 10 p 9 refs
(USNRDL-TR-608)

When sodium in a Krebs-Ringer-type media was replaced by choline, the potential difference across rat stomach as measured *in vitro* was substantially eliminated. Substitutions of sulfate for chloride and of sodium for potassium did not affect the bioelectric measurements. A residual potential of –2MV was detected, which was sensitive to anoxia and dependent neither on sodium nor on chloride. Author

N63-13588 Aerospace Medical Div. School of Aerospace Medicine, Brooks AFB, Tex.
THE RESPONSE OF THE OTOLITH ORGANS TO TILT
Morgan E. Wing Nov. 1962 11 p 10 refs
(SAM-TDR-62-132)

Action potentials and their changes in response to tilt were recorded from 60 units in the vestibular ganglion, presumably supplying the otolith organs of 10 cats. The action potentials in all units were infrequent and irregular after position was maintained for some time. The majority of the units showed no response to any change in position. In most cases of those which exhibited a response, the responses were delayed an average of 40 seconds. The evidence presented supports the view that the utricle and saccule may be vestigial organs, or at least do not function meaningfully in the orientation of the cat with respect to the gravitational field. Author

N63-13644 Aerospace Medical Div. School of Aerospace Medicine, Brooks AFB, Tex.
CHANGES IN SERUM LIPID CONCENTRATIONS WITH AGE IN YOUNG MEN
Dale A. Clark Jan. 1963 14 p 18 refs
(SAM-TDR-62-142)

Data are presented which were obtained during a longitudinal study of serum lipid levels in more than 400 men. Between the ages of 19.6 and 27.5 years, these men exhibited significant increases in concentration of serum cholesterol, phospholipid, and low-density lipoproteins. Changes in cholesterol concentration are significantly associated with changes in S_f 0 to 12 lipoprotein concentration. Changes in S_f 20 to 400 lipoprotein and in body weight are less closely associated. Author

N63-13676 Naval Ordnance Test Station, China Lake, Calif.
PORPOISE PERFORMANCE TESTS IN A SEA-WATER TANK
Thomas G. Long and Dorothy A. Daybell Jan. 1963 54 p 17 refs
(NAVWEPS-8060; NOTS-TP-3063)

This report deals with a series of tests—consisting of measurements of top speed, horsepower output, and drag coefficient—made to determine how a porpoise's power compares with that of other mammals, and how its hydrodynamic characteristics compare with those of conventional man-made submerged bodies. Results of the tests indicated no unusual physiological or hydrodynamic phenomena; power values were comparable to human power levels. These results, however, are in conflict with observations of unusual sea-animal performance reported in the open literature. Because the tank used in the tests may have affected test results, it is recommended that further tests be conducted under open-ocean conditions and their results checked against the results arrived at in this report. Author

N63-13749 Pasadena Foundation for Medical Research, Calif.
RADIOPROTECTIVE AGENTS: THE EFFECTS OF DEPOLYMERIZED YEAST RIBONUCLEIC ACID ON RADIATED HUMAN CELLS IN TISSUE CULTURE
Donald Edwin Rounds and William C. Slick Brooks AFB, Tex., School of Aerospace Medicine, Oct. 1962 8 p 5 refs
(Contract AF 41(657)-337)
(SAM-TDR-62-85)

Yeast ribonucleic acid was hydrolyzed with NaOH to produce polynucleotide mixtures which were tested for radioprotective activity on cultured cells. The depolymerized RNA stimulated the growth rate of amnion cells during 5-day treatment periods, but had no effect on growth when the cells were treated for a 24-hour period. A 24-hour treatment of amnion cells with the nucleotide mixture prior to 700 r gamma radiation resulted in an increase in the surviving cell populations. This effect appeared to reach a maximum with a polynucleotide concentration of 0.3 mg./ml. The RNA hydrolysate had no significant effect on radiated KB cells, but surviving HeLa and amnion cell populations were increased by 19 percent and 63 percent, respectively, over controls. This radioprotective response was detected after a minimum of 4 hours of treatment of amnion cells with the test material. Author

17 MACHINE ELEMENTS AND PROCESSES

Includes: bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control; and materials fabrication, handling, and inspection.

For related information see: 06 Auxiliary Systems.

N63-13372 Los Alamos Scientific Lab., N. Mex.
FLEXIBLE NEUTRON SHIELDING SYSTEMS BASED ON VINYL PLASTISOLS
James S. Church and John K. Donahoe Feb. 28, 1963 31 p
(Contract W-7405-eng-36)
(LAMS-2800) OTS: $0.75

A method has been developed for fabrication of cast, flexible neutron shielding. The process is based on filled polyvinyl chloride (PVC) plastisol system which can be fabricated by either slush casting or low-pressure compression molding. Filler concentrations of 50 w/o boron or boron carbide are readily attained with retention of a fair degree of flexibility. Author

N63-13410 Standard Pressed Steel Co., Jenkintown, Pa.
HI TI 815 SERIES ELEVATED TEMPERATURE TITANIUM FASTENERS FOR APPLICATIONS TO 750° F Laboratory Report
Edward F. Gowen, Jr. Feb. 1, 1963 39 p
(SPS-797)

This report introduces the Hi Ti 815 series of titanium bolts for tensile and shear applications to 750° F. Included in this series are: (1) EWB T815, a twelve-point tension bolt; (2) SP T815, a hexagon head shear bolt; (3) SFT T815, a 100° flush head shear bolt with Torq-Set drive; (4) SFH T815, a 100° flush head shear bolt with Hi-Torque drive. The Hi Ti 815 Series is fabricated from 7Al-12 Zr, an all alpha titanium alloy. The room-temperature properties of the bolts are: ultimate tensile strength, 145,000 psi minimum; ultimate double shear strength, 90,000 psi minimum; and they meet NAS 621 fatigue requirements. These room-temperature properties are virtually unaffected after 100 hours' exposure at temperatures to 750° F. This is the first series of titanium bolts to exhibit this combination of stability and fatigue strength. Author

N63-13414 Los Alamos Scientific Lab., N. Mex.
EPOXY POTTING SYSTEMS FOR HIGH VOLTAGE, HIGH AMPERAGE CIRCUITRY
E. Phillip Ehart and James S. Church Feb. 21, 1963 29 p
(Contract W-7405-eng-36)
(LAMS-2797) OTS: $0.75

Practical solutions have been developed for problems involved in the potting of electrical coils for use at high voltage and high amperage. Specific epoxy resin-fiberglass combinations are discussed as well as the particular requirements for which they were formulated. No attempt at theoretical analysis of the materials system has been made, and no abstract property evaluation tests were performed. The methods developed are not well suited to quantity production processing. Author

N63-13415 Los Alamos Scientific Lab., N. Mex.
FORMULATING OF A LOW STATIC ACCUMULATING, RESILIENT VINYL COATING FOR EXPLOSIVE HANDLING EQUIPMENT
John K. Donahoe and James S. Church Feb. 25, 1963 27 p
(Contract W-7405-eng-36)
(LAMS-2798)

A material system has been developed for use in coating machine-tool-equipment components to aid in preventing accidental detonation of high-explosive materials during machining operations. A graphite-filled, plasticized polyvinyl chloride composition produces a resilient coating with capability to leak-off or dissipate charges of static electricity. The coating is tough, abrasion resistant, and capable of being repaired if torn or otherwise damaged in use. Author

N63-13416 Los Alamos Scientific Lab., N. Mex.
A BRIEF SURVEY OF PRODUCTION TECHNIQUES USED AT LASL FOR FABRICATION OF CUSTOM GASKETS
Pierre F. Hartshorne and James S. Church Feb. 26, 1963 40 p
(Contract W-7405-ENG-36)
(LAMS-2799)

A summary is presented of techniques used at the Los Alamos Scientific Laboratory (LASL) for producing a diversity of especially designed seals. Sealing problems considered have involved isolation of gases from gases, liquids from liquids, and gas systems from liquid systems. Static and kinetic sealing problems have been encountered at pressure differentials from zero to approximately 3,000 psi, and operational temperatures have ranged from −20° C to +300° C. This paper is essentially a catalog of practical problems and their solutions. General principles are given which are standard and in relative agreement with commercial practices. Author

N63-13457 Lockheed Missiles and Space Co., Sunnyvale, Calif.
LUBRICATION UNDER SPACE/VACUUM CONDITIONS Technical Report
Francis J. Clauss Oct. 1962 69 p refs
(Contract AF 04(647)-787)

The effects of space environment on friction, wear, and the selection of lubricants and self-lubricating materials for spacecraft mechanisms are discussed, with special emphasis on the ultrahigh vacuum of space. Experimental studies have demonstrated the feasibility of using selected oils and greases to lubricate loaded ball bearings without replenishment for periods of over one year under the following conditions of operation: speeds of 8000 rpm, temperatures of 160° to 200° F, and vacuum of 10^{-8} torr. Over one-half year of successful operation has been achieved under similar operating conditions with self-lubricating retainers of reinforced Teflon, provided that the loads were light. Bonded films of molybdenum disulfide have given shorter lifetimes and poor reproducibility. Metal-to-metal slip-ring contacts introduce excessive electrical noise into circuits when operated in vacuum of 10^{-7} torr. The noise (as well as the friction and wear) can be markedly reduced by providing a small amount of oil vapor, sufficient to maintain a pressure on the order of 10^{-6} torr, or by incorporating molybdenum disulfide into the brush material. Author

N63-13487 South Carolina U., Columbia
AN INVESTIGATION OF OIL FILM THICKNESS BETWEEN INVOLUTE GEAR TEETH Final Report, October 11, 1960 through October 11, 1962
I. O. Mac Conochie, L. C. Hsu, and E. C. Woodward, Jr. [1962] 36 p 27 refs
(Grant DA-ORD-31-124-61-G30)
(AROD-2458-41)

Research was conducted to formulate an analytical description of relaxation effects in lubricants. Attempts were made to correlate experimental data of percent boundary operation with a dimensionless grouping of the load, speed, and viscosity. This report contains the results and conclusions of a study of the four basic factors (surface deformation, surface roughness, squeeze films, viscoelasticity) which influence gear lubrication and load-carrying capacity. A review of the technique used in these investigations is included. Author

N63-13529 Franklin Inst. Labs. for Research and Development, Philadelphia, Pa.
THE FLOW AND FRACTURE OF ZONE-REFINED TUNGSTEN Quarterly Progress Report, October 1, 1962 to December 31, 1962
John R. Wiese [1963] 14 p
(Contract DA-36-034-ORD-3747RD)
(Q-B1973-2; WAL-TR-834.2/11-1)

A description and pictures of the equipment and apparatus to be used for the induction zone-refining of tungsten is presented. Design and mechanical problems have been overcome, and the system is ready for experimental zone refining passes. Author

N63-13539 National Aeronautics and Space Administration. Washington, D.C.
EXPLOSION WELDING (SVARKA VZRYVOM)
V. S. Sedykh, A. A. Deribas, Ye. I. Bichenkov, and Yu. A. Trishin Mar. 1963 14 p 9 refs Transl. by Faraday Translations, from Svarochnoye Proizvodstvo (Moscow), no. 5, 3-6, 1962
(NASA TT F-140) OTS: $0.50

The possibility of welding metals of the same and different types, and also of obtaining welded joints of large area, by means of an explosion has been experimentally established. The experiments show that the types of explosives used are of major importance, the most suitable for this purpose being low-density explosives in granular form. Author

N63-13655 Wyman-Gordon., Worcester, Mass.
THE FABRICATION OF BERYLLIUM POWDER FORGING
N. G. Orrell, C. J. Morris, and P. J. Doyle, Jr. [1963] 85 p 1 ref
Presented at the U. of Calif. In the course Beryllium—Its Properties and Applications, Mar. 4-8, 1963
(RD-62-105)

The actual manufacturing details of the beryllium powder forging process and the mechanical properties of the forged beryllium powder are discussed. I.v.L.

N63-13656 Aro, Inc., Arnold Air Force Station, Tenn.
CRYOPUMPING CHARACTERISTICS OF SHIELDED LOW TEMPERATURE SURFACES
W. G. Kirby Arnold Engineering Development Center, Mar. 1963 55 p 12 refs
(Contract AF 40(600)-1000)
(AEDC-TDR-63-28)

Experimental cryopumping results for nitrogen and carbon-dioxide gas are presented for shielded 20° K surfaces. These data were obtained in the free-molecule and transition flow regimes in the pressure range of from 10^{-8} to 10^{-3} torr. Theoretical pumping speeds are calculated and compared with experimental values for the molecular flow regime. Transition flows were found to approach values several times greater than those found for the free-molecular flow regime. An empirical equation of the Knudsen type is presented for the transition regime. Author

N63-13677 General Electric Co. Flight Propulsion Lab. Dept., Cincinnati, Ohio
LOW VISCOSITY BEARING STABILITY INVESTIGATION Space Power Operation First Quarterly Project Status Report for period ending Feb. 9, 1962
[1962] 65 p 16 refs
(NASA Contract NAS3-2111)
OTS: $6.60 ph, $2.15 mf

The program objective is to select and develop bearing configurations that promise stable operation up to the high speeds typical of space turbomachinery (35,000 r.p.m.). A high-speed test rig, which is precision made for interchangeability of a large variety of bearing configurations and rotors, will be used to record rotor and bearing motions, as well as other parameters affecting bearing operation. The testing will be carried out at close to room temperature with lubricants which simulate the low viscosity and lubricity of liquid metals at operating temperatures. The experimental testing will be supplemented by analytical studies necessary to select the most promising bearing configurations, and to reduce test results to dimensionless parameters. B.J.C.

N63-13678 General Electric Co., Space Power and Propulsion Section, Cincinnati, Ohio
LOW VISCOSITY BEARING STABILITY INVESTIGATION Quarterly Report No. 4 For Period Ending November 9, 1962
[1962] 63 p 5 refs For abstract see N63-13677 08-17
(NASA Contract NAS3-2111)
OTS: $6.60 ph, $2.09 mf

N63-13708 Arde-Portland, Inc., Paramus, N.J.
CRYOGENIC STRETCH-FORMING OF SOLID-PROPELLANT ROCKET CASES Quarterly Technical Report No. 2, September 1, 1962 to December 1, 1962
George Claffy [1962] 29 p
(Contract DA-30-069-ORD-3501)

Major emphasis was placed on configuration development in subscale vessels. Progress has been made towards perfecting the elliptical head shape, skirt attachment technique, and port attachment technique. Thirteen subscale vessels were cryogenically stretched. Equations for defining the plastic behavior of preform shapes subjected to internal pressurization are being developed. Such expressions can predict the shape a preform vessel will attain at any given level of pressurization. Computer programs are being utilized in connection with the analytical approach. A forming tank, in which full-scale vessels will be refrigerated and stretched in liquid nitrogen, was completed. A support framework was also completed. Author

N63-13750 Mechanical Technology, Inc. Latham, N.Y.
EXPERIMENTAL INVESTIGATION OF SURFACE TEMPERATURE IN ROLLING—SLIDING CONTACTS
F. K. Orcutt Jan. 31, 1963 22 p 10 refs
(Contract Nonr-3729(00) (FBM))
(MTI-63TR3)

A study was made of surface temperature in rolling-sliding contacts using elastohydrodynamic lubrication in an effort to extend machine life and reliability. Use of thermocouples to obtain temperature measurements of a surface in concentrated rolling-sliding contact proved satisfactory. Overall electrical noise level in the thermocouple circuit was reduced to a level equivalent to 1° to 2° F temperature difference so that a dynamic measurement sensitivity of the order of 2° or 3° F could be predicted with confidence. For the low loads and rolling speeds used in the experiments to date (20,000 psi max. contact pressure, 600 rpm), there was no detectable surface temperature rise in the contact zone except at very high sliding-rolling speed ratios (as high as 90%). J.R.C.

18 MATERIALS, METALLIC

Includes: cermets; mechanical and physical properties of alloys and metals; and metallurgy.

For related information see: 07 Chemistry; 17 Machine Elements and Processes; 19 Materials, Non-metallic; 33 Stresses and Loads; and 34 Structural Design.

N63-13338 Naval Research Lab., Washington, D. C.
CREEP-RUPTURE OF NICKEL OF TWO PURITIES IN CONTROLLED ENVIRONMENTS
P. Shahinian and M. R. Achter Jan. 22, 1963 15 p 23 refs
(NRL-5880) OTS: $0.50

In a comparison of the creep characteristics of nickel in a nitrogen atmosphere with those in a vacuum at 900° to 1500° F, it was found that the nitrogen atmosphere promotes intergranular cracking, increases creep rate, and reduces time to rupture. The effects are much greater for an impure (99.8 percent) than for a pure (99.99 percent) grade of nickel. In a similar manner, both air and a helium-oxygen mixture can decrease strength, but they may also, under conditions of temperature and strain rate conducive to oxidation, improve rupture time. To explain the effects of nitrogen on nickel, it is proposed that the gas interacts with grain boundary impurities and lowers the energy necessary for crack propagation. Author

N63-13419 Mound Lab., Miamisburg, Ohio
ACTINIUM AEC Research and Development Report
G. Bouissiéres Feb. 7, 1963 30 p 116 refs Transl. by H. W. Kirby from the book "Nouveau Traité de Chimie Minérale, v. VII p 1413-1446 Paris, Masson et Cie, 1960
(Contract AT-33-1-GEN-53)
(MLM-1147 (Tr)) OTS: $0.75

Data presented for the element actinium covers: isotopes and nuclear properties; preparation from ores; electrolytic deposition; chemical properties; methods for determination; atomic weight; and compounds of actinium. R.C.M.

N63-13472 Aerojet-General Corp. Structural Materials Div., Azusa, Calif.

STRESS-CORROSION CRACKING OF HIGH-STRENGTH ALLOYS [Eighth Quarterly Progress Report, 1 October - 31 December 1962]

R. B. Setterlund Feb. 1963 28 p
(Contract DA-04-495-ORD-3069)
(Rept. 0414-01-8)

A study is made of the stress-corrosion cracking of high-strength alloys. Data, to date, show that the 6Al-4V titanium alloy is immune to stress-corrosion cracking under the annealed condition and in the quenched-and-aged condition. It has been found that stress-corrosion cracking occurs in both 18% and 20% nickel maraging steels. The 20% nickel steel, if not cold worked, is found to crack in a branching intergranular pattern when exposed to distilled water, salt water, or a high-humidity atmosphere. However, when this same alloy is cold worked before aging, it appears to become immune to cracking in all three of these environments. The 18% nickel maraging steel, when cold worked and aged, cracks in distilled water and in a high-humidity environment; the cracking pattern suggests possible failure along slip-planes. J.R.C.

N63-13498 General Electric Co. Vallecitos Atomic Lab., San Jose, Calif.

REMARKS CONCERNING MATERIALS FOR NUCLEAR SUPERHEAT FUEL CLADDING

H. H. Klepfer, D. L. Douglass, W. V. Cummings, M. B. Reynolds, and K. C. Antony AEC Div. of Tech. Inform., Sept. 4, 1962 46 p 23 refs
(Contract AT(04-3)-189)
(GEAP-4060) OTS: $1.00

Recent studies on the metallurgical and mechanical stability of alloys in the nuclear superheat environment are summarized to point out areas for further experimentation. The summary includes studies on corrosion, physical metallurgy, and radiation effects. The results of these studies cast doubt on the use of precipitation-strengthened nickel-base alloys as superheat fuel-cladding and indicate that studies on Inconel, Incalloy, and low-interstitial stainless alloys should be continued. R.C.M.

N63-13499 General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.

EVALUATION OF 300 SERIES STAINLESS STEEL TUBING FOR FUEL CLADDING

R. F. Kirby AEC Div. of Tech. Inform., Oct. 1962 34 p 1 ref
(Contract AT(04-3)-189)
(GEAP-4095) OTS: $0.75

An evaluation program was undertaken to determine the quality of commercially available 300-series stainless-steel tubing and establish acceptance standards and specifications for such tubing in fabricating fuel elements for nuclear superheat applications. The evaluation was accomplished by determining the occurrence frequency and character of tubing defects, using ultrasonic techniques. The effects of these defects upon tubing burst strength were determined by burst testing artificially defected tubing samples at temperatures in the range of 1250° F to 1350° F. Tensile tests were performed on tubing samples at 1300° F to extend the knowledge of tubing tensile properties into the temperature range expected in superheat applications. Author

N63-13535 Horizons Incorporated, Cleveland, Ohio

REINFORCEMENT OF NICKEL CHROMIUM ALLOYS WITH SAPPHIRE WHISKERS Interim Report No. 1, 28 September 1962-28 December 1962

Robert H. Kelsey Feb. 19, 1963 34 p 4 refs
(Contract NOw-63-0138-c)

Strong bonding of iron, nickel, chromium and 347 stainless steel to pure alumina disks has been accomplished. The pure metals, in the presence of their naturally occurring oxides, could be bonded without additives; alloys of the same metals required additives for the formation of a strong bond. Small amounts of aluminum metal and/or calcium ion have been found to promote the formation of a bond between 347 stainless steel and alumina, and between 80/20 nickel/chromium alloy and alumina. Study of the thermodynamics of the system iron/oxygen/alumina indicate that dissolved oxygen may play an important role in the formation of the metal-whisker bond. Author

N63-13545 Thompson Ramo Wooldridge, Inc. Tapco Div., Cleveland, Ohio

AN INVESTIGATION OF THE CORROSION RESISTANCE OF METALLIC MATERIALS TO MOLTEN LITHIUM HYDRIDE AT CYCLIC ELEVATED TEMPERATURES

E. J. Vargo and D. B. Cooper June 1962 159 p 25 refs
(NASA Contract NAS5-462)
(ER-4774)

The corrosive effects of lithium hydride, lithium, and varying mixtures of lithium hydride and lithium upon various structural metals were investigated. These materials included iron-base, nickel-base, cobalt-base and refractory-base alloys as well as unalloyed molybdenum and titanium in the form of tubing. Sealed metal capsules of different designs containing the corrosive medium were used as test specimens. Multimetallic combinations of several of these metals were also employed in these tests. The tests were conducted in air, argon, and hydrogen atmospheres for periods up to 3008 hours, and were either conducted at static temperatures of 1500° or 1600° F or were cycled between the temperatures of 1165° and 1600° F. The relative permeability to hydrogen was also determined for these materials. Various coatings were evaluated for their effectiveness as hydrogen diffusion barriers. Author

N63-13556 Republic Aviation Corp., Farmingdale, N.Y.

OXIDATION STUDY OF A TUNGSTEN-THORIUM ALLOY

Barry Hyatt Dec. 4, 1962 36 p 4 refs
(RAC-1032; ARD-979-250)

The oxidation behavior of tungsten-7½ % thorium oxide at 4000° F has been compared with the oxidation behavior of unalloyed tungsten. Erosion rates for the alloyed tungsten were found to be comparable to those of the unalloyed tungsten. It is postulated that the oxidation of tungsten at temperatures above 3500° F is dependent on the dissociation of O_2 into atoms and their diffusion through a complex boundary layer. Experimental techniques are described for the oxidation testing of tungsten at 4000° F. A high-frequency induction technique was found to be satisfactory, although uncertainties arose in measuring the temperature. Microstructural observations are described for the reacted unalloyed as well as for the alloyed tungsten. As a supplemental project, an in-house aluminide coating was applied to the tungsten materials and oxidation-tested. This coating, however, was not found to be protective at 4000° F. Author

N63-13574 Battelle Memorial Inst., Columbus, Ohio

INVESTIGATION OF THE YIELD PHENOMENON IN ZIRCALOY-2 AT ELEVATED TEMPERATURES

Frederic R. Shober, Ralph W. Getz, Paul B. Shumaker, Arthur P. Young, Maurice F. Amateau, and Ronald F. Dickerson Feb. 14, 1963 42 p 13 refs
(Contract W-7405-eng-92)
(BMI-1616) OTS: $1.00

The yield phenomenon in Zircaloy-2 was studied using elevated temperature short-time tensile tests, internal-friction measurements, and electron microscopy. The phenomenon was found to exist at temperatures greater than 450° F to as high as 750° F. The effects of heat treatment, hydrogen content, loading rate, and grain size on the yield point were studied. Techniques were developed for preparation of thin foil sections of zirconium and Zircaloy-2 for electron transmission studies. Dislocations were observed in annealed zirconium. Internal-friction measurements also indicated a temperature dependency of the internal-friction decay with time corresponding to the presence of a yield point, but did not identify a mechanism. Two irradiation capsules designed to obtain in-reactor creep data for Zircaloy-2 at 650° F were fabricated and tested. Failure of specimen and capsule components occurred during irradiation before creep values were obtained. Author

N63-13583 Air Force Systems Command. Foreign Technology Div., Wright-Patterson AFB, Ohio

A METAL FOR STEAM TURBINES WITH HIGH AND SUPER-CRITICAL STEAM PARAMETERS

E. S. Ginzburg Jan. 10, 1963 24 p 8 refs Transl. from Povysheniye Parametrov Para I Moshohnosti Agregatov V Teploenergetike, Sbornik Statey, Gosenergoizdat (Moscow), 1961 p 112-121
(FTD-TT-62-1273/1+2+4)

The materials used in the fabrication of the SVK-150-1 steam turbine are discussed along with the problems involved in the fabrication of components to withstand these operating conditions, e.g., a speed of 3000 rpm with steam parameters of 170 Mw and 550° C. Possibilities for upgrading materials to meet future turbine needs are considered. R.C.M.

N63-13615 Air Force Systems Command. Foreign Technology Div., Wright-Patterson AFB, Ohio

DEFORMABLE ALUMINUM ALLOYS (SELECTED ARTICLES)

Dec. 31, 1962 25 p 20 refs Transl. from Deformiruyemyye Alyuminiyevyye Splave, Oborongiz Sbornik Statey, Moscow, 1961 p 131-136, 189-194, 195-199
(FTD-TT-62-1272/1+2+4)

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2. HOT CRACKING OF ALLOYS OF THE V95 TYPE I. I. Novikov and A. E. Semenov p 8-14 15 refs (See N63-13617 08-18)
3. SOME FEATURES OF OBTAINING INGOTS FROM THE ALLOYS AM_g5V AND AM_g6 V. A. Livanov, R. M. Gabidullin, and L. P. Donorskaya p 15-22 5 refs (See N63-13618 08-18)

N63-13616 Air Force Systems Command. Foreign Technology Div., Wright-Patterson AFB, Ohio

FEATURES OF THE THERMAL TREATMENT OF HEAVY FORGINGS OF D1 ALLOY

V. I. Isayev, I. A. Ivankin, V. I. Kulakov, and N. A. Loktionova *In its* Deformable Aluminum Alloys (Selected Articles) p 1-7 Dec. 31, 1962 p 1-7 1 ref (See N63-13615 08-18)

The cause and prevention of crack formation in the mechanical treatment of heavy drop forged articles of deformable aluminum alloys is discussed. Large residual thermal stresses appearing in quenching were shown to be the cause of spoilage from crack formation in heavy alloy forgings. Raising the heating temperature for quenching increases the tendency to cracking in the forgings. To eliminate crack spoilage from forgings, it is necessary to keep strictly to the temperature of heating for quenching and to use hot cooling media (water heated to 80° or a fusion of salts at 145° to 155° in step quenching). A.R.B.

N63-13617 Air Force Systems Command. Foreign Technology Div., Wright-Patterson AFB, Ohio

HOT CRACKING OF ALLOYS OF THE V95 TYPE

I. I. Novikov and A. E. Semenov *In its* Deformable Aluminum Alloys (Selected Articles) Dec. 31, 1962 p 8-14 15 refs (See N63-13615 08-18)

The effects of various elements on V95-type aluminum alloys were determined by the technological ring test in anticipation of raising the level of hot crack resistance occurring in continuous ingot casting. Changing manganese, iron, silicon, and magnesium content of the alloys may decrease the tendency to form hot cracks. The effect of manganese, iron, and silicon on hot crack formation was shown to be connected with a change in plasticity of the elements when in solid solution in continuously cast ingots. The technological ring test can be used to evaluate the effect of the changes in chemical composition on hot crack formation in industrial aluminum alloys during continuous casting. A.R.B.

N63-13618 Air Force Systems Command. Foreign Technology Div., Wright-Patterson AFB, Ohio

SOME FEATURES OF OBTAINING INGOTS FROM THE ALLOYS AM_g5V AND AM_g6

V. A. Livanov, R. M. Gabidullin, and L. P. Donorskaya *In its* Deformable Aluminum Alloys (Selected Articles) Dec. 31, 1962 p 15-22 5 refs (See N63-13615 08-18)

Measures for decreasing the formation of hot cracks in AMg5V and AMg5 alloys, and measures to increase the density and strength of the alloys by changing the conditions found in the formation of the oxide coating were studied. Both investigations involved determining the optimun content of various elements included in the alloys. To decrease hot crack formation, it is necessary to: keep the iron content—silicon content ratio higher than 1.5; keep the manganese content of the alloy at 0.50-0.55%; and prepare the beryllium charge in the amount of 0.0001% to 0.0002%. To increase the density and strength of the alloys, the titanium and vanadium content in AMg6 and AMg5V alloys must be 0.02% to 0.05% to obtain ingots without gross accumulations of intermetallic compounds. A.R.B.

N63-13734 General Electric Co. Vallecitos Atomic Lab., San Jose, Calif.

SPECIFIC ZIRCONIUM ALLOY DESIGN PROGRAM First Quarterly Progress Report, February—June 1962

H. H. Klepfer, D. L. Douglas, and J. S. Armijo AEC Div. of Tech. Inform., July 1, 1962 124 p 69 refs
(Contract AT(04-3)-189)
(GEAP-3979) OTS: $2.50

A program has been initiated for the design of a zirconium-base alloy for application as nuclear fuel cladding for steam service. Thirty-one alloys whose compositions were chosen from the alloy field have been arc-melted and are being fabricated to sheet. Specimens cut from the sheet will be tested for response to composition. The response parameters will measure corrosion resistance at 300°, 400°, and 500° C, mechanical properties before and after corrosion exposure, and hydrogen take-up during corrosion. The experiment is designed to permit analysis of the results employing computer programing to determine the optimum composition within the selected alloy field. Film-stripping techniques have been developed in order to permit studies of the partitioning of alloying element between the corrosion film and the alloy substrate. Hydrogen overvoltage measurements have been made for the intermetallic phases Zr_2Cu, Zr_2Ni, for Zr-90% Nb and for crystal bar zirconium. The diffusion of oxygen in bulk nonstoichiometric zirconium oxide has been measured. The activation energy is in agreement with that for parabolic corrosion of zirconium alloys, indicating that bulk oxygen diffusion in the corrosion films and not short-circuiting diffusion paths are rate controlling. Oxygen diffusion in alloy oxide-doped zirconium oxide is now being studied. Author

N63-13773 Southern Research Inst., Birmingham, Ala.
THE THERMAL PROPERTIES OF TWENTY-SIX SOLID MATERIALS TO 5000° F OR THEIR DESTRUCTION TEMPERATURES [Final] Technical Documentary Report, 1 May 1960 to 30 April 1962
C. D. Pears et al Wright-Patterson AFB, Ohio, Directorate of Materials and Processes, Jan. 1963 451 p 3 refs
(Contract AF 33(616)-7319)
(ASD-TDR-62-765)

The thermal expansion, heat capacity, thermal conductivity, total normal emittance, electric resistivity, and thermoelectric voltage were investigated for 26 refractory materials, including the borides, carbides, nitrides, oxides, ATJ graphite, tungsten, and alloys of molybdenum and columbium. The temperature range was from 500° F to 5000° F. In addition to these thermophysical properties, the density, chemical analysis before and after temperature exposure, and microscopic pictures before and after temperature exposure are included to define the materials and assist in the analysis of the data. Author

19 MATERIALS, NON-METALLIC

Includes: mechanical and physical properties of non-metals (e.g., plastics).

For related information see: 07 Chemistry; 17 Machine Elements and Processes; 18 Materials, Metallic; 33 Stresses and Loads; and 34 Structural Design.

N63-13442 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
STRUCTURAL TRANSFORMATION IN PYROLYTIC GRAPHITE ACCOMPANYING DEFORMATION
W. V. Kotiensky and H. W. Martens Nov. 1, 1962 14 p 20 refs
(NASA Contract NAS7-100)
(JPL-TR-32-360) OTS: $1.60 ph, $0.80 mf

Electron microscopy and X-ray diffraction techniques have been used to follow the structural changes which accompany deformation in one lot of pyrolytic graphite, when stress is applied parallel to the substrate direction. Basal slip and an increase in preferred orientation account for deformations up to 20%. Fracture across the basal planes, with subsequent basal slip, an increase in porosity, and a very slight increase in preferred orientation account for deformations above 20%. Rows of etch pits which may be dislocations parallel to the substrate direction were observed in a specimen heated without load to 3000° C. Author

N63-13526 France. Office National d'Études et de Recherches Aéronautiques, Chatillon-sous-Bagneux
ÉTAT DE SURFACE DES FIBRILLES DE VERRE. VISUALIZATION DES DÉFAUTS [GLASS-FIBER SURFACE CONFIGURATION. DEFECTS VISUALIZATION]
Arthur Kh. Iablokoff Dec. 1962 27 p 2 refs In French; English summary
(ONERA-TN-70-1962)

This study shows that surface irregularities existing in the fibers, even when just drawn, are responsible for initiation of lateral cracks. These cracks increase in depth because of the handling process following drawing and because the fibers are wound on cylinders too small in diameter. The width of the "baby" cracks is below the micron and can be spotted only by use of the electronic microscope. Author

N63-13553 Brookhaven National Lab., Upton, N. Y.
GRAPHITE PROBLEMS IN AIR-COOLED REACTORS
Donald G. Schweitzer and Robert M. Singer Oct. 1962 10 p 9 refs
(BNL-758(T-281)) OTS: $0.50

Oxidation, radiation-induced dimensional expansions, and accumulation of stored energy are three major problems affecting long-term use of graphite in air-cooled reactors. Frequent low-temperature annealing eliminates these problems and may extend the lifetime of the graphite indefinitely. Author

N63-13665 Armour Research Foundation, Chicago, Ill.
DEVELOPMENT OF A Ti-Al-Cb ALLOY FOR USE AT 1200°-1800°F [Final Report, May 1, 1960-July 31, 1961]
Joseph B. Mc Andrew and Charles R. Simcoe Wright-Patterson AFB, Ohio, Directorate of Materials and Processes, Mar. 1962 43 p
(Contract AF 33(616)-7262)
(ASD-TR-61-446)

Titanium-base alloys containing major amounts of columbium and aluminum are being studied with the object of developing new high-temperature alloys of low density. This report presents the findings of the second year of this program, derived from the preparation and examination of (1) thirty-five quaternary alloys containing small additions of tin, hafnium, or zirconium, (2) four high-purity ternary alloys, and (3) ten-pound melts of Ti-15Cb-10Al and Ti-17.5Cb-15Al. In a number of alloys, improved tensile properties and oxidation resistance resulted from the addition of tin, hafnium, or zirconium, and in some instances, very high strength-density ratios were maintained up to 1800° F. The properties of high-purity alloys were similar to those of alloys prepared with sponge titanium. Author

20 MATHEMATICS

Includes: calculation methods and theory; computers; data processing; and numerical analysis.

For related information see: 08 Communications; 09 Electronics; 10 Facilities; and 22 Navigation and Guidance.

N63-13330 Wisconsin U., Madison
SOME EXTREMAL QUESTIONS FOR SIMPLICIAL COMPLEXES. V. THE RELATIVE AREA OF A KLEIN BOTTLE Technical Summary Report
L. C. Young Nov. 1962 33 p 11 refs
(Contract DA-11-022-ORD-2059)
(MRC-356)

The relative area of a Euclidean Klein bottle is discussed in the light of least area where the polyhedric and polytropic perimeters are orientated. I.v.L.

N63-13331 Wisconsin U., Madison
A FREE BOUNDARY PROBLEM FOR THE LAPLACE EQUATION Technical Summary Report
Jan Odhnoff Nov. 1962 40 p 5 refs
(Contract DA-11-022-ORD-2059)
(MRC-357)

We treat a free boundary problem for the Laplace equation using methods inspired by the work of A. Beurling on this subject. The following theorem is proved. Given two points a_1 and a_2 in the z-plane and a positive continuous function Q, where log Q is sub-

harmonic, there exists a Jordan curve Γ going through a_1, a_2 and ∞ (with orientation $a_1 \to a_2$) such that in the region located to the left of Γ there is a possitive harmonic function u vanishing on Γ and

$$\lim_{\Omega \ni z \to \Gamma} |\operatorname{grad} u(z)| = Q(z).$$

Author

N63-13332 Wisconsin U., Madison

DIFFRACTION OF PULSES BY A HALF-PLANE PART 2. Technical Summary Report

Michael Papadopoulos Dec. 1962 25 p 9 refs
(Contract DA-11-022-ORD-2059)
(MRC-364)

This report is in part an extension and in part a reiteration of material given in MRC report # 293. The essential part of this earlier work was to derive, in the fullest detail, the formula for the scattered field due to a hard half-plane, with a plane pulse for incident field. This result was then extended to other cases of singular field. Incident field, in this study, is that due to a point source of pressure, moving with constant velocity parallel to the edge of the half plane. The results in the case of supersonic source motion are taken from the earlier paper, whereas those for the subsonic source are completely rederived. The scattering of a transient field, due, most generally, to a point source of step function time dependence, which after it is set up moves with a constant velocity in an arbitrary, fixed direction is discussed. A nontrivial extention of the method in which the effect of an electromagnetic dipole field of step-function time dependence is considered, the diffracting obstacle being a perfectly conducting half plane, is presented. Author

N63-13333 Wisconsin U., Madison

PROCEDURES AND DESIGNS USEFUL FOR SCREENING MATERIAL IN SELECTION AND ALLOCATION WITH A BIBLIOGRAPHY Technical Summary Report

Walter T. Federer Jan. 1963 57 p 494 refs
(Contract DA-11-022-ORD-2059)
(MRC-368)

Similarities of genetic and biochemical research on new materials, such as new plant strains and new chemicals in the form of drugs, pesticides, herbicides, and fumigants, are discussed. A screening procedure in plant breeding is outlined; and experimental designs useful for screening are presented. An extensive bibliography is included which covers results for screening programs on plant and animal breeding and for truncation, fragmentation, and censoring of samples. A.R.B.

N63-13334 Wisconsin U., Madison

THE F. AND M. RIESZ THEOREM FOR VECTOR MEASURES Technical Summary Report

Robert Ryan Nov. 1962 11 p 9 refs
(Contract DA-11-022-ORD-2059)
(MRC-370)

The theorem of F. and M. Riesz on analytic measures is generalized to vector valued measures. This result is used to prove a theorem about the boundary values of analytic vector valued functions.

Author

N63-13335 Wisconsin U., Madison

ON THE NUMERICAL SOLUTION OF PROBLEMS ALLOWING MIXED BOUNDARY CONDITIONS Technical Summary Report

Donald Greenspan Dec. 1962 36 p 22 refs
(Contract DA-11-022-ORD-2059)
(MRC-372)

Linear and quadratic formulas are developed for approximating normal derivatives. These are applied in the development of two purely "internal" numerical methods for approximating solutions of elliptic problems with mixed boundary conditions. Theoretical results favor the use of the linear approximation for $\partial u/\partial n$, but meager numerical results favor the use of the quadratic one. As byproduct results, a very accurate numerical method for Dirichlet problems and a method for problems with prescribed oblique derivatives were developed. Author

N63-13336 Wisconsin U., Madison

SOME SIMULARITY SOLUTIONS OF PARTIAL DIFFERENTIAL EQUATIONS OF BOUNDARY LAYER Technical Summary Report

R. Manohar Jan. 1963 26 p 11 refs
(Contract DA-11-022-ORD-2059)
(MRC-375)

Similarity solutions of the boundary-layer equations for laminar, incompressible, unsteady flows in two dimensions and for steady flows in three dimensions have been obtained, using an extension of one-parameter group method of Birkhoff and Morgan. The technique developed here can be used to obtain similarity solutions, in general, in a simple and straightforward manner. Author

N63-13337 Wisconsin U., Madison

THE APPROXIMATE SOLUTION OF AXIALLY SYMMETRIC PROBLEMS. APPENDIX: PROGRAMMING THE APPROXIMATE SOLUTION OF AXIALLY SYMMETRIC PROBLEMS Technical Summary Report

Donald Greenspan and M. Yohe Jan. 1963 25 p 17 refs
(Contract DA-11-122-ORD-2059)
(MRC-377)

A variety of physical problems in such diverse fields as electrostatic field theory, heat and ideal fluid flow, and stress concentration theory reduce, under the assumption of axial symmetry, to the study of the elliptic partial differential equation $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} + \frac{k}{y}\frac{\partial u}{\partial y} = 0$. Dirichlet-type problems associated with this equation are studied on regions whose boundaries include a nondegenerate portion of the x-axis, and exceedingly accurate numerical methods are given for approximating solutions. Author

N63-13343 Iowa State U. of Science and Tech., Ames

ASYMPTOTIC THEORY OF THREE UNEQUAL PROBABILITY SAMPLING PROCEDURES WITHOUT REPLACEMENT Technical Report 1.3

J. N. K. Rao [1962] 17 p 5 refs
(Contract DA-ARO(D)-31-124-G93)
(AROD-2934-3)

Three procedures for sampling without replacement are compared. The population is assumed to be finite with N units. Special attention is given to the case of large N. For the three procedures it is found that the variance of $\bar{Y}$ is the same to order N where $\bar{Y}$ is an estimator of Y and Y is the population total. The efficiency of the three procedures is compared and is found to be practically the same. However, there are some differences in the computational difficulties associated with the different procedures. Author

N63-13344 Iowa State U. of Science and Tech., Ames

UNBIASED RATIO AND REGRESSION ESTIMATES IN MULTI-STAGE SAMPLING Technical Report 1.5

J. N. K. Rao [1962] 17 p 6 refs
(Contract DA-ARO(D)-31-124-G93)
(AROD-2934-7)

Ratio and regression estimators are widely used in sample surveys for estimating the population mean or total of a characteristic "y" by utilizing the supplementary characteristic 'x' for which the population mean is known. Mickey (1959) has given a method of constructing a broad class of unbiased ratio and regression estimators in simple random sampling. This class includes the well-known

Hartley-Ross unbiased ratio estimator. This paper extends Mickey's method to two-stage sampling and constructs two different classes of 'combined' unbiased ratio and regression estimators. A simple method of variance estimation, similar to that proposed by Goodman and Hartley (1958) for the unbiased ratio estimator in simple random sampling, is considered. Author

N63-13345 Iowa State U. of Science and Tech., Ames
ON THE ESTIMATION OF THE RELATIVE EFFICIENCY OF SAMPLING PROCEDURES Technical Report 1.6
J. N. K. Rao [1962] 11 p 4 refs
(Contract DA-ARO(D)-31-124-G93)
(AROD-2934-8)

There are several sampling methods available to increase the precision of the estimator of the population total or mean. When a supplementary variable, x, which is correlated with the characteristic of interest, y, is available for all the N units in the population, one can use any of the following methods: (1) Draw a simple random sample of n units and use a ratio estimator utilizing x. (2) Stratify the population according to x and draw a stratified random sample. (3) Draw a sample of n units with probabilities proportional to sizes x (p.p.s.) with replacement. The purpose of the present paper is to consider the above three methods in all possible ways and estimate the variance of the estimator in one method from a sample drawn by another method. The criterion of unbiassdness is used in finding these estimated variances except, when estimating the variance of the ratio estimator, use is made of the usual procedure of substituting sample estimates for each term in the variance formula. Author

N63-13361 Air Force, Washington, D.C.
THE NEED FOR AN INTERNATIONAL DATA LINK SYSTEM
H. F. X. Hession *In* Radio Technical Commission for Aeronautics, Wash., D.C. Minutes of Fall 1962 Assembly Meeting, Marriott Motor Hotel and the Naval Research Lab., Wash., D.C., Nov. 27-29, 1962 Dec. 5, 1962 15 p (See N63-13356 08-01)
(Paper 173-62/AS-245)

Problems that are involved in producing an agreed standard and system description for an international data link for aeronautical use are discussed. B.J.C.

N63-13362 Teletype Corp., Chicago, Ill.
THE ASA X3.2 CODE
J. F. Auwaerter *In* Radio Technical Commission for Aeronautics, Wash., D. C. Minutes of Fall 1962 Assembly Meeting, Marriott Motor Hotel and the Naval Research Lab., Wash., D.C., Nov. 27-29, 1962 Dec. 5, 1962 4 p (See N63-13356 08-01)
(Paper 174-62/AS/-246)

The background and status of the American Standards Association's X3.2 committee's data code and character set proposals are explained. This Association's objective is to establish for data processing, system standards on a national scale. The relationship between ASA and the International Standards Organization is described: the objective of ISO is to coordinate national standards for voluntary use of preferred standards internationally. B.J.C.

N63-13405 Bowles Engineering Corp., Silver Spring, Md.
PURE FLUID DIGITAL LOGIC WITH A SINGLE SWITCHING ELEMENT
Peter Bauer *In* Diamond Ordnance Fuze Lab., Washington, D.C. Proc. of the Fluid Amplification Symp., Vol. I, Oct. 2-4, 1962 Nov. 15, 1962 p 405-414 2 refs (See N63-13380 08-11)

The principles of conventional electronic logic design (such as "NOR" logic) were employed as the basis for the development of one universal digital element to serve a multitude of logic functions, singly and in combinations. Definite and conclusive evidence was desired to prove the objective not only feasible but practical as well. The selection of the kind of element used in this study is discussed, and preliminary specifications are given. The design and operation of the fluid element selected are described, and pertinent performance characteristics are presented. The principles on which circuit and circuit assembly design were based are discussed, and examples of the main logic functions performed by this element, when used in digital circuits, are given. Circuits which were tested are described together with element interconnection characteristics obtained. Some results of in-circuit measurements, steady state as well as transient, are given. Conclusions are drawn from characteristics. The breadboard circuit assembly, developed during this program, performing the principal logic operations including amplification, inversion, "OR," "NOR," and "AND" gating, is described. Fabrication techniques used and later advances made are mentioned. The feasibility as well as practicability of employing one fluid element to provide most of the basic logic functions needed in digital systems is demonstrated, and the direction of future development is indicated. Author

N63-13406 General Precision, Inc. Kearfott Div., Little Falls, N.J.
HIGH SPEED PNEUMATIC DIGITAL OPERATIONS WITH MOVING ELEMENTS
H. E. Riordan *In* Diamond Ordnance Fuze Labs., Washington, D.C. Proc. of the Fluid Amplification Symp., Vol. I, Oct. 2-4, 1962 Nov. 15, 1962 p 415-436 (See N63-13380 08-11)

A study is made of the Kearfott high-speed pneumatic digital computer used in an all-pneumatic guidance system. Such a system is of interest for applications presenting a severe thermal or radiation environment. Digital data processing was selected for the pneumatic system because it presented no accuracy limitations (as opposed to analog computation), and because it was felt that the digital approach offered greater flexibility of application and design. A pressure gain of ten is readily obtainable. The pressure gain and response speed are inversely related. Based on experimental data thus far obtained, it is estimated that a transit time in the vicinity of 20 microseconds should be achievable at reasonable supply pressures with special geometry of the moving elements. The most obvious applications of pneumatic digital equipment are those in which a severe thermal or radiation environment precludes or seriously hinders the use of electrical equipment. Examples of such situations are: reactor control, control of reactor-power devices, and control of reentry or other very high Mach-number vehicles. J.R.C.

N63-13433 Oslo U. Inst. of Theoretical Physics, Blindern (Norway)
A THEORETICAL INVESTIGATION OF THE CLOSED STATE $(2p)^{2}{}^{3}P$ OF THE NEGATIVE HYDROGEN ION
Einar Wold Uppsala, Almqvist and Wiksells, June 1962 10 p 4 refs
(Supported by Aeronautical Res. Lab., OAR)
(*Its* Rept. No. 13; ARL-62-458)

A theoretical investigation of the closed state $(2p)^{2}{}^{3}P$ of the negative hydrogen ion includes the computation of the energy for this state by means of electronic computers. I.v.L.

N63-13434 Oslo U. Inst. of Theoretical Astrophysics, Blindern (Norway)
ON THE BETHE-HEITLER FORMULA FOR BREMSSTRAHLUNG
Egil A. Hylleraas Sept. 1962 18 p 1 ref
(Research sponsored by Aeronautical Research Lab., OAR, U.S. Air Force)
(*Its* Rept. no. 16; ARL-62-478)

A discussion of the Bethe-Heitler formula for bremsstrahlung includes: (1) a formula for the differential cross section for photon emission; (2) an evaluation of spurs; (3) an expression of the spinors of

the initial and the final state united into four-dimensional matrices; (4) a summation over photon polarization; and (5) the derivation of an equation for determining the total cross section for photon production and the solution of this equation. I.v.L.

N63-13450 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
SYMBOLIC REPRESENTATION OF COMPLEX SYSTEMS
J. S. Brady and Stuart Goff Jan. 15, 1963 27 p 2 refs
(NASA Contract NAS7-100)
(JPL-TR-32-390) OTS: $2.60 ph, $1.01 mf

A number of logical and mathematical concepts relevant to the development of an overall representation of the performance of complex man-machine systems are derived and related to the characteristics of the JPL/NASA Space Flight Operations Complex. The requirements for a rigorous program of model development are defined. Author

N63-13466 Federal Aviation Agency. Systems Research and Development Service, Atlantic City, N.J.
EVALUATION OF TWO MODIFIED TELETYPE 28 ASR FORMAT GENERATORS Final Report
James F. Akers and Eldred C. Jones, Sr. Apr. 1962 69 p 12 refs

This report covers the test and evaluation of two modified Teletype 28 ASR Format Generators to determine the suitability of this equipment, both technically and operationally, for fulfilling the requirements for a remote facility on-line ATC computer input device. To provide a means of comparison, the tests were designed to parallel those conducted earlier on the Aeronutronics FLIDEN and Model 28 ASR Programmatic equipments. Technical tests and evaluation were concerned mainly with investigations of the maintainability and availability of the modified Teletype 28 ASR Format Generator and performing final acceptance testing. In addition, tests were conducted to determine: (1) the adaptability of the equipment to serve as a device for receiving weather information, and (2) its ability to operate on a computer input circuit in parallel with other format generator(s). The results of the evaluations indicate that the format generators are operationally satisfactory for use as on-line computer input devices at a remotely located facility. In addition, the equipments demonstrated compliance will all applicable FAA requirements and specifications during the acceptance testing. Author

N63-13518 Systems Technology, Inc., Inglewood, Calif.
PERFORMANCE CRITERIA FOR LINEAR CONSTANT-COEFFICIENT SYSTEMS WITH RANDOM INPUTS [Final] Technical Documentary Report
Raymond Magdaleno and Julian Wolkovitch Wright-Patterson AFB, Ohio, Flight Control Lab., Jan. 1963 140 p 56 refs
(Contract AF 33(616)-7841)
(ASD-TDR-62-470)

A critical survey and assessment has been made of performance measures and associated criteria for linear constant-coefficient systems with random inputs. The suitability of each criterion for flight-control-system optimization using "pencil and paper" methods has been investigated by considering its validity, selectivity, and ease of application. Simplifications are introduced by substituting for actual flight-control systems those lower order equivalent systems having similar dynamics, and by replacing certain random inputs and criteria with transient analogs and "compatible" deterministic criteria. The latter simplification enables the calculation of random-input performance measures to be replaced by calculations involving more easily visualized deterministic quantities. It is shown that, for stationary inputs, a wide variety of criteria reduce to minimum mean square error. This criterion is easy to use and has a compatible deterministic form, but yields lightly damped systems and is unselective (i.e., the mean square error of a wide variety of off-optimum systems is little higher than that of the optimum). However, no criterion was found that had the advantages of minimum mean square error without comparable or worse disadvantages. For certain nonstationary problems, the probabilistic square error criterion appears promising. Numerous improved techniques for evaluating criteria and several examples are presented. It is concluded that none of the criteria that have been proposed to date are suitable as sole criteria for flight-control-system optimization. Author

N63-13525 New York U. Courant Inst. of Mathematical Sciences, N.Y.
THE SOLUTION OF SOME NON-LINEAR INTEGRAL EQUATIONS WITH CAUCHY KERNELS
A. S. Peters Jan. 1963 40 p 5 refs
(Contract Nonr-285(06))
(IMM-NYU-307)

Function theory techniques are used to solve, explicitly, equations of radiative heat transfer. Steps involved in the linearization of Chandrasekhar's equation are shown as an extension of the function theory. Three Cauchy equations are solved explicitly. In addition, the equations present a formulation of certain nonlinear boundary value problems. A connection between the equations and certain problems in potential theory are shown. A.R.B.

N63-13530 Lincoln Lab., Mass. Inst. of Tech., Lexington
ERROR STATISTICS AND CODING FOR DIGITAL DATA TRANSMISSION OVER TELEPHONE AND TELETYPE CIRCUITS
A. Barr Fontaine Jan. 21, 1963 19 p 4 refs
(Contract AF 19(628)-500)
(Rept. 25 G-14)

Error data taken on four data circuits, two at teletype speeds and two at 1200 bits per second, are analyzed to determine distributions. The significant results of this analysis show: (1) The block error rates for the two 1200-bit-per-second circuits differ by a factor of 20, but, when errors occur, the distribution of errors and runs of words with errors are similar. (2) The block error rates for the two teletype circuits are approximately 100 times greater than for the 1200-bit-per-second circuits, but, when errors occur, the distributions of errors and runs of words with errors are similar. (3) The higher error rate of the teletype circuits is offset by the lower transmission speed, so that error-detection coding provides similar reliability when measured in terms of undetected errors per year. Author

N63-13544 Systems Technology, Inc., Inglewood, Calif.
ENGINEERING ANALYSIS METHODS FOR LINEAR TIME VARYING SYSTEMS Final Report [Apr. 1961-Jan. 1962]
Dunstan Graham, Eugene J. Brunelle, Jr., Walter Johnson, and Harry Passmore, III Wright-Patterson AFB, Ohio, Flight Control Lab., Jan. 1963 276 p 126 refs
(Contract AF 33(616)-7998)
(ASD-TDR-62-362)

Situations of interest to flight-control-system designers result in vehicle equations-of-motion with time-varying coefficients. Specific sets of equations are developed and are attacked by a wide variety of exact and approximate solution methods. The system function is introduced, and an attempt is made to derive system functions for the equations-of-interest. The use of integral transforms in the solution of time-varying coefficient equations is discussed. An operator technique for deriving the explicit equation for a two-degree-of-freedom system is developed, and one of its potential uses is shown in connection with approximate discrete time solutions for coupled systems. Author

N63-13552 Brookhaven National Lab., Upton, N.Y.
CONCERNING POLYNOMIALS ENCOUNTERED IN THE STUDY OF THE DISTRIBUTION FUNCTION OF SPACINGS
L. D. Favro (Wayne State U.), P. B. Kahn (N. Y. State U., Stony Brook), and M. L. Mehta Sept. 1962 8 p 7 refs
(BNL-757(T-280)) OTS: $0.50

An attempt is made to improve the upper bound on the cumulative distribution function F(S), of spacings of eigenvalues of a random matrix. In this process some polynomials are encountered, and their properties are discussed. Author

N63-13589 Aerospace Medical Div. School of Aerospace Medicine, Brooks AFB, Tex.

ANALYSIS OF REPEATED MEASUREMENTS WITH DISPROPORTIONATE SAMPLES FOR TREATMENTS IN A TWO-WAY CLASSIFICATION

Richard C. Mc Nee and Phelps P. Crump Dec. 1962 11 p 3 refs
(SAM-TDR-62-149)

A procedure is given for computing the analysis of variance obtained by fitting constants of the experimental setup where repeated measurements are made on subjects over time, and treatments have a two-way classification with disproportionate subclass numbers. Under certain assumptions, this analysis gives a test of the three-factor interaction, tests of two-factor interactions if there is no three-factor interaction, and tests of main effects if there are no interactions. The advantage of this procedure over the standard procedure of fitting constants is in the amount of computation involved. Author

N63-13610 Wolf Research and Development Corp., West Concord, Mass.

MATRIX OPERATIONS PROGRAM FOR THE EXPERIMENTAL DYNAMIC PROCESSOR Scientific Report No. 1

Carmine Caso, Janet Seltzer, and James Sexton Feb. 22, 1963 75 p
(Contract AF 19(628)-1614)
(AFCRL-63-39)

The Matrix Package is a system of computer programs to perform general matrix operations. The matrix operations that can be performed are solve eigenvalues and eigenvectors, add, inversion, multiplication, subtraction, and transposition. A set of input/output routines and an executive routine are included in this package. The executive routine is designed to allow effective usage of the Package by people with minimal programing experience. This Package has been coded for the Experimental Dynamic Processor, DX-1. Author

N63-13626 Army Missile Command. Advanced Systems Lab., Redstone Arsenal, Ala.

EQUATIONS AND FORTRAN PROGRAM FOR VISCOUS COMPONENTS OF THE TOTAL NORMAL-FORCE AND PITCHING-MOMENT COEFFICIENTS FOR A BODY OF REVOLUTION

Alma S. Marks Nov. 30, 1962 29 p 5 refs
(RF-TR-62-12)

Equations and a FORTRAN program are presented for computing the viscous components of the total normal-force and pitching-moment coefficients for a body of revolution with varying Mach numbers and angles of attack. Author

N63-13633 Wisconsin U., Madison

A SET OF MATRICES FOR TESTING COMPUTER PROGRAMS Technical Summary Report

J. L. Brenner (Stanford Research Inst.) May 1962 8 p 1 ref
(Contract DA-11-022-ORD-2059)
(MRC-325)

A set of matrices is defined, and the complete solution of each matrix is given. The matrices have arbitrary dimension, and a large number of parameters. By adjusting these parameters, a matrix of arbitrary dimension, which is derogatory (has fewer than the maximum possible number of eigenvectors), or is as nearly singular as desired, can be constructed which has two eigenvectors that are nearly coincident. Thus, a convenient set of check matrices is available for testing computer programs which purport to solve or invert a matrix. For selected values of the parameters, the matrices appear as variance-covariance matrices in statistics. In particular cases, the eigenvalues (but not the eigenvectors) and the determinants have been found. J.R.C.

N63-13638 Systems Technology, Inc., Inglewood, Calif.

SENSITIVITY AND MODAL RESPONSE FOR SINGLE-LOOP AND MULTILOOP SYSTEMS [Final Report]

D. T. Mc Ruer and R. L. Stapleford Wright-Patterson AFB, Ohio, Flight Control Lab., Jan. 1963 116 p 14 refs
(Contract AF 33(616)-8024)
(STI-TR-123-3; ASD-TDR-62-812)

Two related facets of feedback system analysis are considered—the calculation of closed-loop response and the determination of the effects on closed-loop behavior of variations in open-loop parameters. The connection between the modal response coefficients (partial fraction expansion coefficients of the closed-loop transfer function), the sensitity of the closed-loop poles to variations in the open-loop gains, poles, and zeros, and classical sensitivity is developed. A comprehensive summary is given of methods for determining modal response coefficients and sensitivities from open- or closed-loop transfer-function representation. Response formulas for periodic or power-series inputs are derived in terms of the modal response coefficients, with conventional error coefficients as a special case. The initial developments are for single-loop systems with first-order closed-loop poles; these are extended to cover multiple-order closed-loop poles, and generalized to multiloop systems. Author

N63-13659 Edo Corp., College Point, N.Y.

INTRODUCTION TO ACOUSTICAL SPACE-TIME INFORMATION PROCESSING

Alan A. Winder and Charles J. Loda Washington, D.C., Office of Naval Research, Jan. 1963 198 p refs
(ACR-63) GPO: $1.25

A discussion of acoustical space-time information processing includes: (1) representations of functions, (2) effects of bounds on functions, (3) derivative and nonuniform samplings, (4) amplitude quantization, (5) descriptions of spatial structure, (6) orthogonality and integral transforms, (7) linear analysis of circuit elements, (8) linear analysis of spatial elements, (9) circuit filters, and (10) space-time aspects. I.v.L.

N63-13675 Iowa Inst. of Hydraulic Research, Iowa City

LAGALLY'S THEOREM FOR MULTIPOLES

L. Landweber Feb. 1963 10 p 5 refs
(Contract Nonr-1611(01))

Forces and moments on spheroids in arbitrary flows were investigated using alternative, compact expressions for the force and the moment. The momentum theorem for the vector $\vec{F}$ exerted on the body of a fluid is $\vec{F} = -\int_{S_c}(P\vec{N}+\rho\vec{V}\vec{V}.\vec{N})dS$, where S_c is the control surface; S is a bounding surface; P is the pressure; $\vec{N}$ is the unit vector normal to S directed outwards from the region bounded by S_c and S; ρ is the mass density of the fluid; $\vec{V}$ is the velocity vector at a point of the fluid; and the integral extends over S_c. This theorem was proven using Bernoulli's pressure equation and Gauss's transformation. The angular momentum theorem for the moment $\vec{M}$ on the body due to fluid pressures, $\vec{M} = -\int_{S_c}(P\vec{R}\times\vec{N}+\rho\vec{R}\times\vec{V}\vec{V}.\vec{N})dS$, where $\vec{R}$ is the position vector from the origin, was proven using Bernoulli's pressure equation and Gauss's transformation. I.v.L.

N63-13689 Air Force Cambridge Research Labs. Geophysics Research Directorate. Bedford, Mass.

ON A THEORY OF TURBULENT DIFFUSION

J. Chadam (MIT) Dec. 1962 30 p 24 refs
(Contract AF 19(604)-6181; NSF Grant G-21515)
(AFCRL-62-1107)

Fundamental ideas and techniques of the theory of Brownian motion are applied to the phenomenon of turbulent diffusion. It appears that in the Lagrangian sense the motion of a particle in a turbulent fluid is governed by a Langevin equation similar to that arising in recent theories of Brownian motion except that the correlation of the random accelerations is not a strict delta function. Averaging techniques are discussed, and turbulent diffusion in a homogeneous isotropic medium is examined. It is shown that an 'unjustified' Markhov assumption provides the desired asymptotically Gaussian density function for the displacement. Richardson's "distance-neighbor" function is considered, but an intrinsic difficulty is found with the differential equation proposed for the function by Richardson. The more general situation of turbulent diffusion in a medium with uniform density gradient is discussed, and the dispersion coefficient is computed from the modified Langevin equation and found not to satisfy Richardson's Law. Author

N63-13765 European Atomic Energy Community, Brussels (Belgium)

ANALOG PROGRAMMING AND CHECKING (APACHE I)

G. Del Bigio and H. d'Hoop Joint Nuclear Research Center, Ispra Establishment (Italy), Scientific Information Processing Center, Jan. 1963 37 p In French; English abstract

(CETIS Rept. 15; EUR 189.f) Available from the Belgian American Bank and Trust Co., N.Y., account No. 121.86: 50 Belg. Fr.

The APACHE code described is the first attempt made at the J.R.C. EURATOM of Ispra for programing an analog computer by means of a digital computer. The input is a list of parameters, variables and equations punched on paper tape. The program scales the variables and computes the potentiometers, setting values for the static-check, and printing the results on the typewriter. This report is intended to help the analog programer in writing APACHE programs, gives full details on the language to be used and its limitations, and shows the digital operator how to run the program. Particular attention has been given to error reset to avoid waste of time. A description of the program is given. Author

N63-13766 European Atomic Energy Community, Brussels (Belgium)

THREE WORKINGPAPERS ON THE THEORY OF COMPUTATION

L. A. Lombardi Joint Nuclear Research Center, Ispra Establishment (Italy), Scientific Information Processing Center, Jan. 1963 43 p 6 refs

(EUR-192.d,e; CETIS Rept.-49) Available from Belgian American Bank and Trust Co., N.Y., account No. 121.86: 60 Belg. Fr.

CONTENTS:

1. ON TABLE OPERATING ALGORITHMS p 1-12 7 refs Paper presented at IFIP Congress, Munich, Germany, Aug. 27-Sept. 1, 1962
2. THE DECLARATIVE CONTROL OF THE DATA FLOW BY MEANS OF RECURSIVE FUNCTIONS p 13-33 16 refs Paper presented at Symposium on Symbolic Languages in Data Processing, International Computation Centre, Rome, Italy, March 26-31, 1962
3. ZWEI BEITRAGE ZUR MORPHOLOGIE UND SYNTAX DEKLARATIVER SYSTEMSPRACHEN [TWO CONTRIBUTIONS TO THE MORPHOLOGY AND SYNTAX OF DECLARATIVE SYSTEM LANGUAGES] p 34-40 6 refs Presented at the DMV-GAMM Meeting, Bonn, W. Germany, April 24-28, 1962 In German

N63-13770 Space Technology Labs., Los Angeles, Calif.

A NEW APPROACH TO THE THEORY OF BARYONS

H. C. Corben Jan. 1963 8 p 4 refs Preprint

The spin, charge, and mass of baryons are calculated by the relativistic wave equation $(i\epsilon_\mu P_\mu + Mc)\psi = 0$ where $P\mu = p\mu - \frac{e}{c}A\mu$, $M = m + m_0\epsilon\mu\nu\lambda\mu\nu$, and m, m_0 are arbitrary parameters. The values determined from these calculations show good comparison with experimental values, e.g., the calculated mass of the Y_0^{**} particle was 2918 m_e and the observed mass was 2975 m_e. R.C.M.

N63-13771 Polytechnic Inst. of Brooklyn. Microwave Research Inst., N.Y.

SENSITIVITY OF SOME LOW ORDER BANG-BANG CONTROL SYSTEM

Prem Shivdasani Feb. 4, 1963 52 p 15 refs

(Grant AF AFOSR-62-295)

(PIBMRI-1081-62)

A study is made of the sensitivity of some low order bang-bang control systems with and without damping. Techniques are developed for approximating the true impulse response of the plant by a truncated power series. This term is a two-term least-square fit to the time impulse response over a specified time interval. Such an approximation leads to a switching boundary involving power terms only and no transcendentals. It is shown that the two series coefficients can be obtained from the process transfer function. Phase-plane analysis is used to obtain the switching curves for second-order integral processes with and without damping. The response of the plant, under study, to variations in plant parameters is investigated, and the response is obtained using piece-wise linear methods of the switching logic. J.R.C.

21 METEOROLOGY

Includes: climatology; weather forecasting; lower atmosphere studies; and oceanography.

For related information see: 05 Astronomy and Astrophysics; 12 Geophysics; and 29 Space Sciences.

N63-13470 Arctic Inst. of N. America, Montreal (Canada)

METEOROLOGICAL AND GLACIOLOGICAL STUDIES, ICE RISE STATION, WARD HUNT ISLAND, MAY TO SEPTEMBER 1960 Scientific Report No. 5

R. B. Sagar July 1962 92 p 35 refs

(Contracts AF 19(604)-8343 and AF 19(604)-3073)

(AINA Res. Paper-24; AFCRL-62-848)

An account of the surface climate on the Ward Hunt Ice Rise from May to early September 1960 is given. The relative importance of the ablation season heat-balance components is assessed from accumulation and ablation data, subsurface temperature changes, and microclimatological observations. The principal energy source is the net flux of radiation. The net energy gain due to turbulent transfer is considered to be small or even negative over the whole ablation season. Various observations are compared with those of the 1959 season. It is concluded that relatively small changes in the amount of accumulation and in the radiative energy flux, or in both, can have a marked effect on the mass balance of the Ward Hunt Ice Rise and Ice Shelf. Author

N63-13546 Stanford Research Inst., Menlo Park, Calif.

RADAR PRECIPITATION ECHO AND SATELLITE CLOUD OBSERVATIONS OF A MARITIME CYCLONE Scientific Report 3

Roland E. Nagle and Sidney M. Serebreny Repr. from J. of Appl. Meteorol., v. 1, no. 3, Sept. 1963 p 279-295 18 refs

(Contract AF 19(604)-5982)

Satellite-observed cloud patterns for five days during the evolution of a major, extratropical maritime cyclone associated with a strong Ω-shaped blocking pattern were studied for the period when the storm existed over a radarscope data-collection network. Cloud distributions at 24-hr. intervals were compared with the surface and upper-level synoptic conditions to ascertain cloud-synoptic pattern, precipitation-pattern relationships. Precipitation distributions are shown in relationship to the cloud features which appear to be characteristic of extratropical maritime cyclones. The very low percentage of clouds that precipitate at any given time is strongly reemphasized, as well as the limited area within a storm in which precipitating clouds are found. Shower patterns within cellular-type convective clouds are shown to develop in the same configuration as the clouds and to be subject to diurnal effects. These showers were found to have lasted at least two hours, a considerably longer period than comparable continental air-mass showers. Minor cloud vortices were found which persisted along regions of confluence of contrasting air masses around the periphery of the major spiral cloud pattern associated with the storm; these minor vortices appeared to rotate with the gross cloud pattern and were loci of heavy precipitation activity. Author

N63-13560 Stanford Research Inst., Menlo Park, Calif.
THE USE OF SYNOPTIC-SCALE WEATHER RADAR OBSERVATIONS IN THE INTERPRETATION OF SATELLITE CLOUD OBSERVATIONS Final Report
R. E. Nagle and R. H. Blackmer, Jr. Dec. 1962 301 p 33 refs
(Contract AF 19(628)-284)
(AFCRL-63-223)

Analyses are made of Tiros I vidicon observations of the earth's cloud cover using precipitation data collected from a synoptic-scale network of radars. Forty comparisons between satellite-observed cloud patterns and simultaneous radar-detected precipitation areas are presented, illustrating attempts to determine if precipitating clouds exhibit characteristics that distinguish them from nonprecipitating clouds. Interpretations of various cloud forms observed in the satellite photographs, using precipitation as detected by surface and airborne radar, are also presented. These interpretations consider the time and space variability of precipitation and precipitation kinematics in relation to the observed cloud forms and other more conventional meteorological observations. No characteristics are found that will allow a specific determination to be made of clouds that are of precipitating nature. However, on a gross scale, the brightest clouds are found to have been associated with areas of precipitation. It is found that precipitation associated with vortices occurs in spiral-banded configuration. Squall lines appear to be an integral part of this pattern. Author

N63-13586 Air Force Systems Command. Foreign Technology Div., Wright-Patterson AFB, Ohio
IS THERE A STORM ALONG THE AIR ROUTE?
N. Makarov Jan. 8, 1963 13 p Transl. from Grazhdanskaya Aviatsiya, (USSR), no. 9, 1962 p 22-24
(FTD-TT-62-1679/1+2)

The meteorological aspects of air traffic control are pinpointed to the flight dispatcher to enable him to detect dangerous weather conditions. The need is shown for the dispatcher to supplement radar weather data with information from crew reports. The dispatcher should pay particular attention to the origination of thunderstorms within existing cloud systems. The approximate altitude of these cloud systems can be obtained by shutting off the two upper channels of a three channel radar and changing the angle of antenna inclination until the cloud image fades. R.C.M.

N63-13685 Technische Hochschule Darmstadt. Inst. für Meteorologie (W. Germany)
ON THE EULEREAN AND LAGRANGEAN STATISTICS OF VERY LARGE-SCALE ATMOSPHERIC MOTIONS Technical Note No. 1
F. Wippermann, P. Gburčik (Belgrade U.), and W. Klug Aug. 31, 1962 45 p 7 refs
(Contract AF 61(052)-366)
(AFCRL-63-237)

A simple vortex model of atmospheric turbulence is described; it consists of symmetric solid vortices of different size, rotation, and frequency, traveling with a basic current constant in space. Using this vortex model, an interrelation is derived between the Lagrangean and the Eulerean correlation functions. Both these correlation functions are evaluated for the case of atmospheric macroturbulence in a barotropic fluid over the Northern Hemisphere for a period of 8 days. This evaluation involves special operations necessary to eliminate the influence of the time interval of averaging and the influence of inhomogeneities of the zonal basic current. The derived relation is verified by the simultaneously observed Lagrangean and Eulerean correlation functions. Author

N63-13725 Royal Aircraft Establishment, Farnborough (Gt. Brit.)
THE PHYSICO-METEOROLOGICAL PRINCIPLES OF BAROMETRIC HEIGHT MEASUREMENT (ALTIMETRY) (DIE PHYSIKALISCH-METEOROLOGISCHEN GRUNDLAGEN DER BAROMETRISCHEN HOHENMESSUNG)
E. Rossger and G. Ranike London, Ministry of Aviation, Nov. 1962 37 p 21 refs Transl. from Z. Flugwiss. (Brunswick, W. Germany), v. 10, no. 1, 1962 p 1-17
(RAE Library Translation 1018)

The physicometeorological principles underlying barometric-height measurement (altimetry) are considered. The extent to which a conclusion can be drawn from a measurement of pressure with regard to the height above any terrestrial reference level is investigated in particular. The errors arising from various meteorological conditions are discussed as well as the various subscale-settings. The methods presently in use for correcting the indicated altitude by temperature measurements are examined in detail, and the correction formulae which apply to the use of arithmetical and barometric mean temperatures are given. The considerations are illustrated by five computed model atmospheres. Author

22 NAVIGATION AND GUIDANCE

Includes: autopilots; star tracking; inertial platforms; and traffic control.

For related information see: 06 Auxiliary Systems; 08 Communications; 09 Electronics; 10 Facilities; 15 Instrumentation; 20 Mathematics; and 29 Space Sciences.

N63-13368 Motorola, Inc. Aviation Products Div., Culver City, Calif.
AUTOMATIC FLIGHT CONTROL AND INSTRUMENTATION
E. F. O'Brien *In* Radio Technical Commission for Aeronautics, Wash., D.C. Minutes of Fall 1962 Assembly Meeting, Marriott Motor Hotel and the Naval Research Lab., Wash., D. C., Nov. 27-29, 1962 Dec. 5, 1962 13 p (See N63-13356 08-01)
(Paper 181-62/AS-253)

Design, development, packaging, and instrumentation for a new automatic flight control system are discussed. The system will be designed to provide five major functions: (1) a three-axis autopilot function, (2) a flight computer function, (3) a course director function, (4) a calibration card function that meets the aerodynamics of each aircraft model, and (5) a reliability function over the environmental requirements. B.J.C.

N63-13743 Royal Geographical Society. Inst. of Navigation, London (Gt. Brit.)

NON-MILITARY NAVIGATION BY SATELLITES

Alton B. Moody (NASA) Repr. from the J. Inst. of Navigation, v. 16, no. 1, Jan. 1963 p 9-13

The possibility of using the Transit Satellite System for nonmilitary navigation is discussed. I.v.L.

23 PHYSICS, GENERAL

Includes: acoustics; cryogenics; optics; and thermodynamics.

For astrophysics see: 05 Astronomy and Astrophysics.

For related information see: 12 Geophysics; 29 Space Sciences; 24 Physics, Plasma; and 24 Physics, Solid-State.

N63-13354 Avco-Everett Research Lab., Everett, Mass.

THE PROSPECTS FOR ACTIVE SHIELDING

R. H. Levy Nov. 1962 17 p 4 refs
(Nonr-2524(00))
(AMP-94)

A review is given of the reasons for the interest in active shielding, and the types of missions for which an active shield would be particularly desirable are discussed. Recent work on active shielding is reviewed. Electrostatic shielding is then discussed. In general, the maintenance of an electrostatic field for shielding purposes will require the expenditure of power owing to the presence of a neutral, highly conducting plasma. Estimates of the power required are extremely high, and electrostatic shielding appears unattractive. Magnetic shielding is discussed next. The virial theorem on the weights of magnetic field coils in space is explained, and it is shown how this theorem can be used to make a direct comparison between the use of a material as an element in a structure and as a stopping material for energetic protons. The result of this comparison is that for sufficiently large sizes magnetic shielding will always be superior, but that the sizes involved are extremely large. The way in which the critical size scales with the strength-to-weight ratio for structural materials and the magnetic field strength is discussed. This general view is supplemented by a review of the status and prospects for large superconducting radiation shields, with particular emphasis on those features which are likely to make the minimum weights estimated by the virial theorem unduly optimistic. The possibility of shielding a spacecraft by blowing a hole in the interplanetary magnetic field (along which the protons move) with an atomic bomb is mentioned. It appears that such a shield would violate Liouville's theorem. Author

N63-13378 Pennsylvania State U., University Park

EFFECT OF RADIATION ON DYNAMIC PROPERTIES OF HIGH POLYMERS Progress Report, covering Period July 1, 1961 to June 30, 1962

J. A. Sauer July 1, 1962 16 p
(Contract AT(30-1)-1858)
(TID-16273)

New information on radiation effects has been obtained for polystyrene, polyethylene terephthalate, polytetrafluoroethylene, polypropylene and epoxy resins. Proton magnetic resonance techniques have been used to study temperature-induced molecular motion in paraffins and polyethylene, and in a variety of polymers and monomers, including those containing α-methyl groups as well as the α-olefins. Dielectric studies have been completed on various polyamides and some unusual irradiation effects noted. Effects of various factors on transitions in high polymers have been explored both by dynamic mechanical techniques and by NMR, and some interesting low temperature transitions have been discovered in the region below 80° K. Thermal conductivity measurements of polymers over a wide temperature range have been inaugurated, and investigations of methods of preparation and of properties of polymer single crystals have been continued. Experimental and theoretical investigations of vibrations and attenuation in homogeneous and inhomogeneous systems and in samples of various shapes are also leading to new knowledge. Installation of temperature and humidity controls has allowed improved precision in measurement of dielectric and thermal expansion properties of polymers at low temperatures. Author

N63-13427 Ronson Metals Corp. Research and Development Div., Newark, N. J.

MATERIALS FOR AND THE MECHANISM OF GETTERING MULTIPLE COMPONENT GASES Final Report, Covering Period July 8, 1962-Sept. 8, 1962

L. Epstein and L. J. Kaufman Jan. 22, 1963 45 p 9 refs
(Contract AF 19(604)-8430)
(AFCRL-63-7)

Experimental work has dealt with the reactions of a thorium-cerium-aluminum getter (CerAlloy 400) and titanium with carbon dioxide and nitrogen. Spectra are presented as obtained with the omegatron mass spectrometer in the presence of the two getters in a closed system, as well as in a system open to diffusion pumping, in the pressure range below 10^{-5} torr. Diffussion constants and partition coefficients, calculated from pressure-versus-time curves, have been tabulated. A substitution resulted in the transformation of the original theoretical equation into one from which log (P-P_f) could be determined as a linear function of long elapsed time. The diffusion constant was calculated from the slope of this line, and the partition coefficient was determined from its extrapolated zero time intercept. Author

N63-13432 North Carolina State Coll. School of Physical Sciences and Applied Mathematics, Raleigh

A TIME CORRELATION TECHNIQUE FOR INVESTIGATING TWO CONNECTED NUCLEAR TRANSFORMATIONS Final Report, Oct. 1960-June 1962

Wesley O. Doggett [1963] 11 p 9 refs
(Grant DA-ORD-31-124-61-G49)
(AROD-2543-8)

The most accurate method for measuring millisecond half-lives consists of producing the radioactive isotope with a pulsed accelerator, and counting the radiations after the pulse with a multichannel time analyzer. In studies of nuclear decay schemes, it is of interest to determine if different radiations are part of a decay chain or are independent of each other. The pulse method is not well suited for investigating chains. The delayed coincidence technique has been extremely successful when the daughter half-life is in the range 10^{-4} to 10^{-10} second. Severe count rate restrictions prevent its use in the millisecond range. The time correlation method, however, provides a means for measuring half-lives in the range 10^{-4} to 1 second of daughter activities that are in secular equilibrium with longer lived parent radioactive nuclides. This report summarizes studies using the time correlation method. Author

N63-13446 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena

LEAST-SQUARE ANALYSIS OF GAMMA-RAY PULSE HEIGHT SPECTRA

J. I. Trombka Dec. 15, 1962 33 p 12 refs
(NASA Contract NAS7-100)
(JPL-TR-32-373) OTS: $3.60 ph, $1.19 mf

The pulse-height spectrum due to a polyenergetic distribution of gamma rays is synthesized by using a series of normalized pulse-height distributions resulting from the monoenergetic components in the incident beam. All of these monoenergetic pulse-height distributions are weighted so their sum is a best fit, based upon a least-square criterion, to the experimentally determined poly-energetic pulse-height distribution. There is difficulty in the application of least-square technique to the analysis of pulse-height spectra because the problem is nonlinear in energy. In the technique described, this difficulty has been overcome by using linear methods of solution, but applying the constraint that only positive or zero values be allowed for the intensities or amplitudes of the various monoenergetic components. Author

N63-13458 Oak Ridge National Lab., Tenn.

Thermonuclear Division Semiannual Progress Report for the Period Ending Oct. 31, 1962 [PLASMA PHYSICS AND DCX-1 AND DCX-2 PLASMA EXPERIMENTS]

J. L. Dunlap et al Mar. 4, 1963 109 p 1100 refs
(Contract W-7405-eng-26)
(ORNL-3392) OTS: $2.25

Research with the DCX-1 apparatus was concentrated on correlation of RF signals, neutral-particle emission, slow plasma emission through magnetic mirrors, energy degradation of stored protons, plasma potential, and plasma decay time. Efforts are still being made to gain operating experience with the DCX-2 unit—so far the unit has been only modestly successful in storing protons. Experiments have continued on the confinement of low-energy plasma between magnetic mirrors with the realization that ion cooling is important in the interplay between charge exchange and scattering into the escape cone. A Snooperscope has been converted to a stroboscopic shutter for visual observation of rapid plasma phenomena. Steady-state carbon-arc studies have been continued with measurement, by Doppler broadening, of the temperature reached by ions produced in the arc by cold gas feed; thus He^{+} reached 10^{6} °K, while N^{2+} and A^{2+}, for example, appear to come into equilibrium with the C^{2+} ions at 2.5×10^{6} °K. B.J.C.

N63-13517 Watkins-Johnson Co., Palo Alto, Calif.

STUDY ON SOLID BEAM GUNS Interim Engineering Report No. 3, Covering the Period 22 November 1962 through 21 February 1963.

Robert Frost [1963] 53 p
(Contract AF 33(657)-8858)

The perveance 2.7×10^{-6} gun has been focused with about 95-percent beam transmission. The cathode diameter was .710 inches and the drift tube diameter 0.078 inches. Difficulties in obtaining consistent results from the perveance 2.7×10^{-6} gun were observed. Another single focus-electrode design was evolved from the multielectrode gun by matching the beam boundary potential created by the multielectrodes in a slightly different manner. The resulting gun had a perveance of approximately 3×10^{-6}, somewhat closer to the perveance of the multielectrode gun. The beam boundary potential profiles of this perveance 3×10^{-6} gun and the perveance 2.7×10^{-6} gun are compared. A two-element focus electrode has been designed for the perveance 4×10^{-6} gun from the multielectrode design. Author

N63-13533 Radio Corp. of America. Defense Electronic Products, Camden, N.J.

PROTON RADIATION DAMAGE STUDY Third Monthly Progress Report, July 1-Aug. 1, 1962

D. M. Arnold and D. A. Gandolfo [1962] 12 p
(NASA Contract NAS1-1654)
OTS: $1.60 ph, $0.80 mf

Radiation effects on semiconductor devices, as a function of proton particle energy, are investigated. Progress is reported for studies on the following: defect density and device performance for neutron bombardment; proton-induced lattice displacements; and transmutations. B.J.C.

N63-13534 Radio Corp. of America. Defense Electronic Products, Camden, N.J.

PROTON RADIATION DAMAGE STUDY Second Monthly Progress Report, June 1-July 1, 1962

James Vollmer and D. A. Gandolfo [1962] 16 p 18 refs
(NASA Contract NAS1-1654)
OTS: $1.60 ph, $0.80 mf

The purpose of this project is to determine radiation effects on semiconductor devices as a function of proton particle energy. Progress is reported for: device selection and data evaluation; defect density calculations for neutron bombardment; and high-energy proton interaction studies. B.J.C.

N63-13536 Bureau of Mines. Albany Metallurgy Research Center, Ore.

THERMOELECTRIC PROPERTIES OF ENARGITE-TYPE COMPOUNDS

Raymond L. Carpenter, John S. Murray, and Thomas D. Roberts 1963 11 p 6 refs
(BM-RI-6200)

The thermal conductivity, electrical resistivity, and Seebeck coefficient for nine compounds, based on the formula for enargite Cu_3AsS_3, were measured in a search for efficient materials to be used in thermoelectric generators or refrigerators. Results indicate that one of these compounds, Cu_3SbSe_4, has thermoelectric properties approaching those of bismuth telluride. An investigation of the effect of adding small quantities of tellurium to Cu_3SbSe_4 and Cu_3SbS_4 in order to improve their properties also was made. A figure of merit of 2.1×10^{-4} °C^{-1} was obtained for Cu_3SbSe_4 + 0.1 percent tellurium. Author

N63-13551 Brookhaven National Lab., Upton, N.Y.

SPARK-CHAMBER LABELING OF TRACKS IN A BUBBLE CHAMBER

J. Fischer and G. T. Zorn July 1962 18 p 12 refs Unabridged version of paper presented at the Intern. Conf. on Instrumentation for High-Energy Phys. at CERN, Geneva, Switzerland, July 1962
(BNL-746(T-272)) OTS: $0.50

A method of studying the interaction of high-energy particles of particular masses in a bubble chamber, when exposed in an unseparated beam, has been devised and experimentally tested. It is based on the labeling of bubble-chamber tracks with the aid of a spark chamber controlled by a particle-selecting counter telescope. By correlating the positions in the spark chamber with those in the bubble chamber, the tracks of the selected particles may be indicated, which permits study of the interaction of these particles in the bubble chamber or their exclusion as an undesired contaminant of the beam. Several particles may be labeled in each bubble-chamber photograph. A preliminary experiment for labeling 5-Bev/c K^{-} tracks in the 20-in. BNL hydrogen bubble chamber is described. The accuracy with which the track position in the bubble chamber was determined was $\approx \pm 3$ to 4 mm in this case; however, it can be improved to $\approx \pm 1$ mm. Methods used in correlating spark position with bubble-chamber track position are presented, and means of improving the precision and the efficiency of scanning and analysis are discussed. The technique may be applied in beams at momenta up to ≈ 200 Bev/c, as it is limited only by the particle-selecting counter system. Author

N63-13561 Massachusetts Inst. of Tech., Cambridge

SPATIAL DISTRIBUTION OF THE NEUTRON FLUX ON THE SURFACE OF A GRAPHITE-LINED CAVITY

J. T. Madell, T. J. Thompson, A. E. Profio, and I. Kaplan AEC Div. of Tech. Inform., Apr. 1962, 336 p 21 refs
(Contract AT(30-1)-2344)
(NYO-9657)

A graphite-lined cavity was built at the outer end of the thermal column of the MIT Reactor. Seven variations of the material and geometrical arrangement of the cavity were made. The neutron flux was measured on the top surface and in the top wall of each variation and also on all surfaces and in the cavity itself of one of the variations. Absolute flux, cadmium ratio, and albedo measurements were made. The experimental results demonstrated that the cavity suitably modified the magnitude, distribution, and direction of the neutrons emerging from the thermal column. A theoretical model was developed to calculate the magnitude and distribution of the neutron flux on the surfaces of a cavity. The values of the view factors and the albedos, which were necessary to calculate the flux in the cavities, were obtained from computer programs. The values of the flux were also calculated by using an electronic computer. The calculated values of the flux are in excellent agreement with the measured values. Author

N63-13563 California U., Berkeley. Lawrence Radiation Lab.
BEVATRON OPERATION AND DEVELOPMENT. XXXII, NOVEMBER 1961 THROUGH JANUARY 1962
Kenneth C. Crebbin, William W. Salsig, William A. Wenzel, and Fred H. G. Lothrop Dec. 14, 1962 21 p 8 refs
(Contract W-7405-eng-48)
(UCRL-10347) OTS: $0.50

Experimental work consisted of: two continuing runs in the 72-inch hydrogen bubble chamber; K^- interactions at 1.2 to 1.95 Bev/c, and $\pi^{\pm}$ differential scattering. A new experiment of K^-–p scattering by using spark chambers (0.33 to 1.4 Bev/c) was begun. An emulsion exposure was made in a 900-Mev/c π^- beam. The flywheels and shaft assemblies for the main generators were changed. A vacuum extension tank was provided for external secondary beams. New induction electrodes and rapid beam ejector coils were installed. A trial poleface winding, and magnetic field and gradient probe were installed. Author

N63-13565 California U., Berkeley. Lawrence Radiation Lab.
PERTURBATION-THEORY RULES FOR COMPUTING THE SELF-ENERGY OPERATOR IN QUANTUM STATISTICAL MECHANICS
Gordon Baym and Andrew M. Sessler Dec. 17, 1962 19 p 8 refs
(Contract W-7405-eng-48)
(UCRL-10562) OTS: $0.50

Convenient rules are given for the general term in the time-independent perturbation-theory expansion for the self-energy operator of quantum statistical mechanics. The rules are derived by starting from the usual formalism involving time-dependent Green's functions. The well-known formulas for thermodynamic quantities in terms of the self-energy operator are included for completeness. Author

N63-13592 Westinghouse Electric Corp. Westinghouse Research Labs., Pittsburgh, Pa.
FIELD-ENHANCED TRANSMISSION SECONDARY EMISSION FOR HIGH-SPEED COUNTING
E. J. Sternglass and G. W. Goetze Mar. 2, 1962 25 p 17 refs
(Sci. Paper 62-112-252-P1)

The time-response of high-gain transmission-type dynodes using KCl in the form of a low-density layer is investigated. Both the results using light-pulses and charged particles directly incident on these dynodes indicate no detectable time lag within the limits of the experimental method ($\lesssim 0.5 \times 10^{-9}$ sec). The number of emitted secondaries under the impact of α-particles and electrons confirms the theoretical expectation that the yield is proportional to the rate of energy loss per unit distance, dE/dx. The results indicate that transmissive dynodes of the low density type with yields between 50 to 100 secondaries per incident 5-Kev electron can be used both for high-speed electron multiplication and direct detection of nuclear particles without the use of scintillators. Author

N63-13594 Denver U., Colo.
IONIZATION OF NITROGEN AND OXYGEN MOLECULES BY NITROGEN AND OXYGEN MOLECULES
Nyle G. Utterback Repr. from Phys. Rev., v. 129, no. 1 Jan. 1, 1963 p 219-224 6 refs
(NASA Grant NsG-50-60)

The ionization cross sections for N_2 and O_2 molecules on impact with N_2 and O_2 molecules have been measured over the laboratory energy range from 20 to 1000 ev. The incident molecular beams were produced by the technique of ionization by electron impact, electrostatic acceleration, and neutralization by charge transfer. The measurements were carried out in a low-pressure parallel plate ionization chamber. Particular attention was paid to the problem of secondary electrons. Ionization was observed a few ev above threshold for all combinations. Cross sections which were obtained ranged from 10^{-20} to 5×10^{-16} cm^2. The N_2-O_2, O_2-N_2, and O_2-O_2 curves of cross section vis incident particle energy showed no apparent structure, as contrasted with N_2-N_2 case. The N_2-O_2 and O_2-N_2 results were in agreement when corrected to center-of-mass energy. Author

N63-13599 Stanford U. Biophysics Lab., Calif.
THIRD INTERNATIONAL SYMPOSIUM ON X-RAY OPTICS AND X-RAY MICROANALYSIS, STANFORD UNIVERSITY, AUGUST 22-24, 1962
[1962] 38 p Program and abstracts only
(NASA Grant NsG-296-62)

This report gives the program and abstracts of papers presented at the third international symposium on X-ray optics and X-ray microanalysis. The subject matter covered includes the following: instruments and techniques; applications of X-ray microscopy; production, detection, and analysis of X-rays; X-ray reflection, microdiffraction, and low-angle scattering; microprobe analysis, theory, and technique; microprobe analysis instrumentation; biological applications of microprobe analysis; and metallurgical and mineralogical applications of microprobe analysis. J.R.C.

N63-13602 United Aircraft Corp. Research Labs., East Hartford, Conn.
RESEARCH ON THE COLLISION PROBABILITIES OF ELECTRONS AND CESIUM IONS IN CESIUM VAPORS Quarterly Status Report No. 3, November 1, 1962 through January 31, 1963
R. H. Bullis and R. K. Flavin Jan. 31, 1963 15 p 3 refs
(NASA Contract NASr-112)
(A-920057-3) OTS: $1.60 ph, $0.80 mf

Included in this research are: (1) the measurement of the total collision cross section of cesium ions with cesium atoms in the energy range of 0.1 ev to 10 ev by a modified Ramsauer apparatus which uses an electro-formed copper collision chamber; (2) modification of the re-entrant type slits on the collision chamber to improve the uniformity of the electroplating in this area; (3) modification of the ion multiplier to include deflection plates in the front of the first dynode; (4) fabrication of the components for the vacuum system; (5) determination of the electron-cesium atom collision cross section by microwave spectrometric measurement of the width of the electron cyclotron resonance absorption spectra of a cesium plasma in a magnetic field; (6) prediction of the velocity dependence of the collision frequency for momentum transfer by examining the detailed structure of the absorption spectra; and (7) a computer program for solving the collision frequency integral for the derivative of the absorption coefficient, where the collision frequency velocity dependence is approximated by a simple power law. I.v.L.

N63-13608 Naval Research Lab., Washington, D. C.
AIRBORNE RADIOACTIVITY FROM NUCLEAR TESTS, 1958—1962
L. B. Lockhart, Jr. *In its* Report of NRL Progress Feb. 1963 p 1-4 2 refs (See N63-13607 08-01) OTS: $1.25

A review is given of the air concentrations of gross β-activity and strontium-90 observed during the past five years at Miami, Florida, and Antofagasta, Chile. The results are interpreted in terms of the past patterns of nuclear testing and the concepts of stratospheric hold-up and preferential deposition during the spring. Extrapolation of past records leads to the conclusion that worldwide radioactivity levels will reach a record high during the coming year, even in the absence of further nuclear testing. Author

N63-13613 California U., Livermore. Lawrence Radiation Lab.
HAZARDS CONTROL Quarterly Report No. 10, July-September 1962
C. L. Lindeken et al [1962] 50 p 12 refs
(Contract W-7405-eng-48)
(UCRL-7143) OTS: $1.25

Progress in hazards control research includes: proposal of a technique that permits detecting long-lived alpha-emitting radioisotopes in the presence of natural background and provides for pulse-height analysis of activity collected on the filter; development of neutron remote-area monitoring system, improvements in neutron dose measurements by attenuation techniques using polyurethane attenuators, development of fire-resistant inlet air filter for metal gloved boxes; establishment of respirator fitting facility and respirator service program; development of a chemical stripping agent to soften epoxy coatings quickly; and determining weathering and light traffic effects on sidewalk test patches. B.J.C.

N63-13614 California U., Livermore. Lawrence Radiation Lab.
THE THERMODYNAMIC FUNCTIONS FOR CARBON DIOXIDE IN THE RANGE 40 TO 1000° C AND 1 TO 1400 BARS
W. E. Sharp Dec. 19, 1962 55 p 9 refs
(Contract W-7405-eng-48)
(UCRL-7168) OTS: $1.25

Tables on the thermodynamic functions for carbon dioxide in the temperature range of 40° to 100° C and the pressure range of 1 to 1400 bars cover: *V*, specific volume in cubic centimeters per gram; *S*, entropy in calories per mole per degree centigrade; *H-Ho*, enthalpy in calories per mole; *G-HO*, Gibbs free energy in calories per mole; *E-HO*, internal energy in calories per mole; *A-HO*, Helmholtz free energy in calories per mole; *HO*, enthalpy at 1 bar and 25° C. B.J.C.

N63-13619 Air Force Systems Command. Foreign Technology Div., Wright-Patterson AFB, Ohio
NEWS OF SCHOOLS OF HIGHER EDUCATION—PHYSICS (SELECTED ARTICLES)
Jan. 10, 1962 30 p 36 refs Transl. of articles from Izv. Vysshikh Uchebn. Zavedenii, Fiz., Tomsk (USSR), no. 1, 1962 p 25-31, 32-35, and 48-51
(FTD-TT-62-1474/1+2+4)

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3. THE INFLUENCE OF GAMMA RADIATION ON DIELECTRIC LOSSES IN MICA K. A. Vodopyanov and I. G. Vorozhtsova (Kuybyshev State U.) p 20-27 11 refs (See N63-13622 08-23)

N63-13620 Kuybyshev (V. V.) State U. Siberian Physicotechnical Inst., Tomsk (U. S. S. R.)
ON THE NATURE OF DIELECTRIC LOSSES IN MICA
I. G. Vorozhtsova *In* Air Force Systems Command. Foreign Technology Div., Wright-Patterson AFB, Ohio. News of Schools of Higher Education—Physics (Selected Articles) Jan. 10, 1962 p 1-12 16 refs (See N63-13619 08-23)

The dielectric properties of mica were measured under reduced pressure to determine the temperature-frequency dependence of dielectric losses (tan δ) and permittivity (ϵ) under vacuum conditions (10^{-4} mm Hg). Disc-shaped 0.25-mm-thick specimens of muscovite roasted at 600° C (M-600) were studied in the frequency range from 20 to 10^5 cps and a temperature range from -80° to +250° C. It was found that the frequency maximum of the tan δ is displaced toward the higher frequencies as the temperature increases, while the ϵ in the region of the maximum of tan δ decreases as the frequency increases. The activation energy of the relaxers proved to be 0.39 ev for these results. Possible structural changes in mica leading to these dielectric effects are discussed including relaxation polarization due to orientation of semibound water molecules. R.C.M.

N63-13621 Kirov (S. M.) Tomsk Polytechnic Inst. (U.S.S.R.)
ON THE MECHANISM OF THE ELECTRIC BREAKDOWN OF SOLID DIELECTRICS
G. A. Vorob'yev *In* Air Force Systems Command. Foreign Technology Div., Wright-Patterson AFB, Ohio. News of Schools of Higher Education—Physics (Selected Articles) Jan. 10, 1962 p 13-19 9 refs (See N63-13619 08-23)

Many laws of the electric breakdown of solid dielectrics and air are similar. However, there are no experimental data which would directly indicate the breakdown mechanism of solid dielectrics. Modern theories of the electric breakdown of solid dielectrics do not consider the development of discharge, and therefore do not give a direction for experimental study of the mechanism of breakdown. An examination of collision ionization in a sample of rock salt 0.1 mm thick indicates the size of the electronic avalanche is 10^{30}, which is unreal. A factor which limits the growth of an electronic avalanche, as calculations show, is the space charge formed as a result of collision ionization. Only in a sample with a thickness of several microns, where the space charge is small, can collision ionization be observed in pure form. In this case hardening of the dielectric, an increase in the delay time and an exponential rise in current must be observed. Experiments conducted confirmed these assumptions. Author

N63-13622 Kuybyshev (V. V.) State U. Siberian Physicotechnical Inst., Tomsk (U.S.S.R.)
THE INFLUENCE OF GAMMA RADIATION ON DIELECTRIC LOSSES IN MICA
K. A. Vodop'yanov and I. G. Vorozhtsova *In* Air Force Systems Command. Foreign Technology Div., Wright-Patterson AFB, Ohio News of School of Higher Education—Physics (Selected Articles) Jan. 10, 1962 p 20-27 11 refs (See N63-13619 08-23)

Dielectric measurements were made on mica to study the effect of gamma radiation on the nature of the curve of temperature versus tan δ and ϵ for muscovite over the temperature range from 20° and to 300° C and the frequency range from 50 to 10^4 cps. Unroasted and heat-treated muscovite was studied. Irradiation was carried out at room temperature with a dose of 50,000 r and dose rates of 400 r/min and 1000 r/min. The results of these studies are presented graphically and indicate the following: (1) The dielectric properties of unroasted muscovite are worse after irradiation due to the ionizing action of the gamma radiation. (2) Irradiation of muscovite roasted at 800° C leads to a sharp decrease in the loss angle over the temperature range from 20° to 100° C, and to an increase at higher temperatures. (3) In muscovite having a disintegrated structure, radiolysis of water is possible by irradiation, which can improve the dielectric characteristics of the mica. R.C.M.

N63-13630 Southwest Research Inst., San Antonio, Tex.
LIQUID SLOSHING IN 45° SECTOR COMPARTMENTED CYLINDRICAL TANKS Technical Report No. 3
H. Norman Abramson, Wen-Hwa Chu, and Luis R. Garza Nov. 1, 1962 16 p 5 refs
(NASA Contract NAS8-1555)
OTS: $1.60 ph, $0.80 mf

Liquid sloshing in 45°-sector compartmented tanks is investigated. Experimental data on frequencies and total force response for a 45°-sector compartmented tank are presented and correlated with theoretical frequencies and with similar data for 90° sector (quarter) tanks. These data show the strong dependence of liquid natural frequency on excitation amplitude and a large decrease in natural frequency with increasing equivalent Reynolds number (based on perforation hole size). B.J.C.

N63-13631 Southwest Research Inst., San Antonio, Tex.
LIQUID SLOSHING IN A SPHERICAL TANK FILLED TO AN ARBITRARY DEPTH Technical Report No. 4
Wen-Hwa Chu (Ph. D. Thesis–Johns Hopkins U.) Dec. 15, 1962 72 p 17 refs
(NASA Contract NAS8-1555; Contract DA-23-072-ORD-1251)
OTS: $7.60 ph, $2.36 mf

The kernel function for liquid sloshing in a spherical tank filled to an arbitrary depth is shown to be related to the Green's function of the second kind and is constructed successfully by numerical means. Natural frequencies are then computed as eigenvalues of a matrix. Eigenfunctions are obtained at a finite number of points as the eigenvectors which are sufficient for approximate evaluation of the force acting on the container. Simple formulas of force and moment are given for both pitching and translational oscillation under a fixed gravitational field. Comparisons of predicted natural frequencies and force response with experiments for a quarter-full tank are also given. Author

N63-13632 Clarendon Lab., U. of Oxford (Gt. Brit.)
INVESTIGATION INTO THE ORIGIN OF CRYSTALLINE ELECTRIC FIELD EFFECTS ON RARE EARTH IONS. I. CONTRIBUTION FROM NEIGHBORING INDUCED MOMENTS Technical Note 12
M. T. Hutchings and D. K. Ray Aug. 1962 34 p 21 refs
(Contract AF 61(052)-125)
(ARCRL-62-945)

In order to determine how far it is possible to account theoretically for crystalline electric field parameters of rare earth ions, a comparison is made between the experimentally determined parameters of Pr^{3+} in $PrCl_3$ and $PrBr_3$ and those calculated on a simple ionic model. A general expression for the contribution of induced moments of any order on neighboring ions to the crystalline electric potential at the rare earth site is given, and this is used to evaluate the contribution of point charges, induced dipoles, and induced quadrupoles to the crystalline electric potential at the Pr^{3+} site in $PrCl_3$; and of point charges, and induced dipoles to the crystalline electric potential at the Pr^{3+} site in $PrBr_3$. The importance of the contribution of the induced moments to the potential is shown, but there are still some large discrepancies between calculated and experimental values. Possible reasons for these are discussed. Author

N63-13634 National Bureau of Standards, Washington, D. C.
BIBLIOGRAPHY ON ATOMIC TRANSITION PROBABILITIES
B. M. Glennon and W. L. Wiese Aug. 1, 1962 54 p 1180 refs
(Sponsored by ONR; Proj. DEFENDER)
(NBS Monograph-50) GPO: $0.35

A bibliography on atomic transition probabilities is presented. The papers are arranged according to elements and stages of ionization, and the method employed and class of transitions are indicated behind each reference. Only articles on discrete transitions, both permitted and forbidden, are listed. Also included is a supplementary list of papers dealing with transition probabilities from a general point of view, a table showing the availability of numerical material on the individual atoms and ions, and a table of conversion factors. Author

N63-13642 Chalmers U. of Tech. Research Lab. of Electronics, Goteburg (Sweden)
DYNAMIC NON-LINEAR WAVE PROPAGATION IN IONIZED MEDIA. 6. SCATTERING OF ELECTROMAGNETIC WAVES BY AN ANISOTROPIC MEDIUM WITH A HARMONICALLY TIME-VARYING DIELECTRIC TENSOR
K. H. B. Wilhelmsson 1962 74 p 28 refs
(Contract AF 61(052)-451)
(Res. Rept. 32; US-31; AFCRL-62-968)

The author's treatment of electromagnetic wave scattering is extended to the case of scattering by an anisotropic medium having a harmonically time-varying dielectric tensor. The properties of the waves generated at sideband frequencies are described in detail. Field modifications at the signal-frequency caused by the interaction of the sideband waves with the pump-oscillations are discussed for both the planar and cylindrical cases. It is demonstrated that the parametric resonance effect may cause a strong reflected signal. The laws governing the angles of reflection and refraction for the different kinds of waves involved in this problem are discussed. R.C.M.

N63-13645 Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.
DC EFFECTS UNDER MICROWAVE EXCITATION OF THIN FERRITE FILMS
William Heinz Oct. 3, 1962 65 p 10 refs
(Contract AF 18(600)-1505)
(PIBMRI-108-62)

Two magnetite (Fe_3O_4) films were investigated at X-band. To build up the fields sufficiently for the signal to be detected, the films were mounted in a cavity. The cavity was critically coupled at ferromagnetic resonance, and the incident peak power was varied between one and three kilowatts. The measured voltage at one kilowatt (microwave magnetic field intensity of 16.8 oe) was 1.2 millivolts, whereas the calculated value using d.c. values of galvanomagnetic coefficients was larger by a factor of about six. The discrepancy is attributed to the difficulty in determining the exact position of the film in the field and to possible changes in the electrical properties with frequency. The linear relation between voltage and incident power, and the reversal of voltage with d.c. magnetic field reversal were confirmed experimentally. The experimental curve shape of the voltage vs. static magnetic field was intermediate between a dispersion-type and an absorption-type. The voltage developed in ferrites is considerably lower than that in ferromagnetic conductors because the effect depends on the microwave current density in the film. Thus, we have a sensitive means for the detection of ferromagnetic resonance in thin films of good conductors, but this application is not practical for ferrite films. In the case of the latter, the phenomenon may shed light on the conductivity, Hall effect, and magnetoresistance at microwave frequencies. Author

N63-13652 Argonne National Lab., Ill.
Physics Division Summary Report, November-December 1962 [EXPERIMENTAL NUCLEAR PHYSICS, MASS SPECTROSCOPY, THEORETICAL PHYSICS, GENERAL]
Morton Hamermesh [1962] 29 p
(Contract W-31-109-eng-38)
(ANL-6666)

Progress is reported on the following studies: neutron polarization and differential cross sections, elastic scattering of protons, gaseous species in equilibrium at high temperatures, and meson-nucleon interactions. A bibliography of publications resulting from these studies is included. R.C.M.

N63-13663 Lockheed Missiles and Space Co., Sunnyvale, Calif.
THERMODYNAMIC PROPERTIES OF NITROGEN. TECHNICAL REPORT: PHYSICS
C. Edward Smith, Jr. Dec. 1962 30 p 7 refs

Equations describing the thermodynamic properties of nitrogen have been formulated. Intermolecular-force effects are included by means of the virial equation of state, and molecular vibrational effects are included by considering the molecules to be harmonic oscillators. The effects of anharmonic vibrational modes and molecular dissociation were neglected. Tables of the properties of nitrogen were computed from the equations for temperatures from 1,000° to 7,500° K, and values of log density from −6.0 to +2.7. Author

N63-13664 General Electric Co. Research Lab., Schenectady, N.Y.
RESEARCH ON SPONTANEOUS MAGNETIZATION IN SOLID BODIES
I. S. Jacobs, D. S. Rodbell, and W. L. Roth Wright-Patterson AFB, Ohio, Directorate of Materials and Processes, Feb. 1962 52 p 12 refs
(Contract AF 33(616)-7396)
(ASD-TR-61-630)

A number of research projects dealing with fundamental interactions and the microstructure of internal fields in selected magnetic materials were carried out. (1) The nuclear magnetic resonance of Co^{59} in metallic cobalt powders has been examined. In addition to the absorption characteristic of Co^{59} in face-centered dubic cobalt, there was found an additional group of absorptions, one of which is clearly associated with hexagonal close packed cobalt. (2) The phenomenon of spin-flopping in antiferromagnetic MnF_2, in which the axis of antiferromagnetism is decoupled from the crystal axes, was observed by magnetization measurements in high-pulsed magnetic fields. Its position coincided with the value, 93 kOe, predicted from measurements of antiferromagnetic resonance with millimeter microwaves. (3) The temperature dependence of the magnetocrystalline anisotropy of face-centered cubic cobalt metal was examined by ferromagnetic resonance on single crystal thin films and submicron precipitate particles in Cu, at temperatures below the range in which this is the stable structure. Satisfactory agreement is obtained for a tenth power law between anisotropy and magnetization. (4) A very brief review of pulsed field-magnetization measurements in compounds was prepared. (5) An investigation of magnetic exchange and structure in lanthanum manganite perovskite compounds spanning the transition between antiferromagnetism and ferromagnetism was performed using neutron diffraction and high field-magnetization techniques. Evidence favored the single-phase canted spin model for this region over the model of a mixture of two crystallographically similar but magnetically distinct phases. Author

N63-13667 National Bureau of Standards, Washington, D.C.
PRESSURE INDUCED SHIFTS OF INFRARED LINES DUE TO POLAR MOLECULES Technical (Scientific) Note No. 2
Earle K. Plyler, M. A. Hirschfeld, and J. H. Jaffe (Weizmann Inst. of Sci., Rehovoth, Israel) Oct. 1962 7 p 9 refs
(Contract AF 61(052)-388)
(AFCRL-63-231)

The pressure-induced shifts of infrared lines due to polar molecules are investigated. In a given vibration-rotation band the individual lines are each shifted differently, and it is this feature of the shifts (the so-called J-dependence) that is of particular interest. The shifts of HCl lines in the 1-0 and 2-0 bands are studied when they are under the influence of He, Ne, Ar, Kr, and Xe. With the exception of values for the first line of each branch (R(0) and P(1)), the shifts in both the P and R branches of a given band are approximately the same both in magnitude and in sign. For Ar, Kr, and Xe the shifts are toward lower frequencies and increase steadily with increasing J. J.R.C.

N63-13672 Avco-Everett Research Lab., Everett, Mass.
SHOCK TUBES: THEIR APPLICATION IN THE STUDY OF PHYSICAL AND CHEMICAL REACTIONS. A Bibliography [1950-1962]
Oct. 1962 30 p 377 refs
(AMP-92)

N63-13679 Maryland U., College Park
SURFACE RESISTANCE OF SUPERCONDUCTORS
Luc Leplae (Ph. D. Thesis—1962) Nov. 1962 98 p 13 refs
(Contract AF-AFOSR-62-46; ARPA-SD-101)
(Tech. Rept. 283)

This discussion concerns: (1) the study of the real part of the conductivity of a superconductor, σ, (ω, g, l), where ω, g, and l are the frequency, wave number, and mean free path; and (2) the application of the formulae obtained to the study of the surface resistance, $R(\omega)$. Author

N63-13683 Hebrew U., Jerusalem (Israel)
THE GROUND STATE SPLITTING AND OPTICAL SPECTRA OF d^5 CONFIGURATION IN CUBIC CRYSTALLINE FIELDS Technical Note No. 3
W. Low and G. Rosengarten Sept. 1962 14 p 9 refs
(Contract AF 61(052)-549)
(AFCRL-63-227)

Gabriel et al. have calculated the ground state splitting for Mn^{2+} ions in a cubic field. Using the same Hamiltonian, calculations have been made of the ground state splitting, the energy level scheme and the wavefunction for Mn^{2+} and Fe^{3+} in a number of crystalline environments. These calculations differ from those of Gabriel in that: (a) rather than use a perturbation procedure, the complete matrix including the spin orbit coupling is diagonalized, (b) attempts are made to get the best fit to the optical spectra and to obtain the corresponding initial splitting, (c) five parameters are used including α, the Tree's correction. It is found that using reasonable values of the spin orbit coupling ζ and crystal field strength Dq, the optical spectra can be fitted but the initial splitting in all cases is too small. Author

N63-13684 Liége U. Inst. d'Astrophysique (Belgium)
MIE SCATTERING FUNCTIONS FOR SPHERICAL PARTICLES OF REFRACTIVE INDEX m = 1.25 Technical Note No. 1
L. Remy-Battiau Nov. 30, 1962 47 p 3 refs
(Contract AF 61(052)-587)
(AFCRL-63-233)

In a discussion of the problems related to the cometary continua, intensity functions and polarization rates of the scattered light have been computed for dielectric spheres of refractive index $m = 1.25$. The range of covered dimensions corresponds to $x = 0.1(0.1)10(1)20(3)50$ (x = ratio of $2\pi a/\lambda$, a being the radius), and the range of scattering angle is $\theta = 0°(2°)10°(10°)170°(2°)180°$. The results are compiled in tables and graphs. Author

N63-13687 Air Force Cambridge Research Labs. Geophysics Research Directorate, Bedford, Mass.
A BIBLIOGRAPHY OF THE ELECTRICALLY EXPLODED CONDUCTOR PHENOMENON [THIRD EDITION]
William G. Chace and Eleanor M. Watson Oct. 1962 123 p 258 refs
(AFCRL-62-1053)

This bibliography includes abstracts of reports on the exploding conductor (previously called 'exploding wire') phenomenon published from 1774 through 1961. There is also some coverage of important papers in adjacent areas of spectroscopy and instrumentation. Arrangement is by subject group, alphabetically by authors. Author

N63-13730 Massachusetts Inst. of Tech., Cambridge
FIELD MEASUREMENTS OF SOUND PROPAGATION
S. K. Oleson and U. K. Ingard Dec. 30, 1959 67 p 10 refs
(NASA Contract NASw-6516) OTS: $6.60 ph, $2.21 mf

Significant results of an experimental study on sound propagation over ground are presented. The purpose of this study was to substantiate theoretical procedures developed in the same program for calculating the sound field from a source over ground under conditions of various temperature and wind gradients. Measurements of sound at octave band frequencies between 150 cps and 4800 cps were taken at ten positions along a horizontal path approximately 4000 feet long and within a height of 20 feet above such ground covers as grass and snow. Results are depicted and compared for sound pressure-level data taken under separate conditions of upwind sound propagation, downwind sound propagation, negative temperature gradients, and no wind or temperature gradients. Negative temperature gradients and upwind sound-propagation conditions were the dominant factors increasing sound attenuation over a given distance. Sound pressure levels measured at far distances downwind from a source were increased above those levels measured at the same positions with no wind. However, this increase was considerably less than the decrease of sound pressure levels observed for a comparable upwind sound-propagation case. Sound attenuation due to rain or fog was found to be negligible at frequencies between 150 and 2400 cps. At frequencies above 1000 cps, sound attenuation due to falling snow became appreciable. Precise comparisons between long-range sound propagation theory and experiments are difficult to make without considering the effects of atmospheric turbulence on sound. If these effects are not taken into account, considerable uncertainties exist in determining and associating true average meteorological conditions with measured average sound pressure level attenuations. However, the principal experimental results are in general agreement with the results of the theoretical procedures developed earlier and with the results of other experimental data. Author

N63-13735 General Electric Co. Vallecitos Atomic Lab., San Jose, Calif.
ABSORBER BURN-UP EXPERIMENT Final Report
J. L. Russell, Jr., M. R. Carrothers, and W. V. Mosgovoy AEC Div. of Tech. Inform., Apr. 1962 117 p 10 refs
(Contract AT (04-3)-189)
(GEAP-4017) OTS: $2.25

Experimental results are presented of pile oscillator measurements of the cross section of irradiated samples of seventeen elements. Mass spectrometer analysis of some samples was performed. Quantitative theory-experiment correlation yields some new thermal-absorption cross-section information, and also establishes the reliability of control-rod lifetime calculations for each element investigated. Application of the results to calculation of the nuclear lifetime of reactor control rods is discussed. Author

N63-13764 European Atomic Energy Community, Brussels (Belgium)
MANUEL DU BLINDAGE DE L'EXPERIENCE CRITIQUE ORGEL (ECO) [MANUAL ON SHIELDING OF THE ORGEL CRITICAL EXPERIMENT (ECO)]
U. Canali, R. Nicks, and C. Pleinevaux Joint Nuclear Research Center, Ispra Establishment, (Italy), Jan. 1963 104 p 11 refs In French; English abstract
(EUR 149.f) Available from the Belgian American Bank and Trust Co., New York account No. 12186: 125 Belg. Fr.

The thickness of the lateral, bottom, and top shields of ECO for the nominal power of 1 kw is given. For reduced power, three bottom shields are proposed. The penetrations in the various shields have been verified, as well as the activity of the cooling air. Author

N63-13769 New York U., N.Y.
DETERMINATION OF FORMATIVE TIME LAGS IN AIR IN A UNIFORM FIELD AS A FUNCTION OF PRESSURE AND ELECTRODE SEPARATION AND DETERMINATION OF FORMATIVE TIME LAGS OF THE VACUUM SPARK Final Report
Leon H. Fisher and Lawrence A. Bornstein Mar. 12, 1963 13 p 36 refs
(Contract Nonr-285(34))

During the period from November 1, 1962, through December 31, 1962, electron transit times for the geometries used in various gases such as hydrogen, argon, oxygen, and nitrogen were computed, and the formative time lags at threshold in these gases were measured. During the rest of this project, principal lines of investigation covered: measurements of formative time lags in uniform fields; measurements of Townsend ionization coefficients and of the attachment coefficient of oxygen; corona studies; glow discharge studies; and vacuum spark studies. B.J.C.

N63-13772 Royal Inst. of Tech., Stockholm (Sweden)
SPEECH ANALYSIS AND SYNTHESIS Final Technical Report [Dec. 1, 1959-Dec. 31, 1961]
C. G. M. Fant. Jan. 31, 1962 104 p 22 refs
(Contracts AF 61(052)-342 and DA-91-591-EUC-1496)
(AFCRL-62-790)

Speech research during 1960 and 1961 is summarized. Parametric synthesis at speech has been developed to an advanced stage with regard to naturalness at a 1 kbit/sec quantization level. Results from analysis work including instrumentation, sampling, techniques, phonetic specification, inverse filtering, pole-zero matching, formant tracking, pitch tracking, perceptive evaluations of spectrum data, and nasalization studies are discussed. Author

24 PHYSICS,PLASMA

Includes: fusion; and magnetohydrodynamics.

For related information see: 05 Astronomy and Astrophysics; 23 Physics, General; and 25 Physics, Solid-State.

N63-13469 National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
ELECTRODE EROSION IN SPARK DISCHARGES
Donald J. Vargo and Frederick L. Taylor Repr. from J. Appl. Phys., v. 33, no. 9, Sept. 1962 p 2911-2912 3 refs Previously processed as a preprint; see N62-12844 08-21

Electrode erosion characteristics of the capacitor discharge systems for rail-type plasma accelerators were studied in high vacua (3 to 5 $\times$ 10^{-6} mm Hg) to determine the dependence of the erosion rate on the characteristics of the discharge. Performance of these accelerators may be strongly affected if electrode erosion processes add mass to the moving plasma. Data were taken with eight different electrode materials—seven pure metals and stainless steel. The highest erosion rates were found in aluminum and tin. Results also indicate that the erosion rate of the electrodes is primarily a function of charge flow for a given material, and that this mass increase must be taken into account throughout the acceleration process in analyses of rail-type accelerators. A.R.B.

N63-13488 Princeton U. Plasma Physics Lab., N.J.

HIGH-FREQUENCY PLASMA CONDUCTIVITY IN A MAGNETIC FIELD

Carl Oberman and Fred Shure (RCA) Jan. 1963 20 p 5 refs
(Contract AT(30-1)-1238)
(MATT-166)

The rigorous expression for the classical high-frequency conductivity of a fully ionized plasma was obtained previously through a joint solution, in the plasma limit, of the first two members of the B-B-G-K-Y hierarchy when both are able to change on the same time scale. The present paper extends that treatment to include the presence of a uniform magnetic field. Through the use of a Fourier-Bessel transformation, the equation for the pair correlation function is made formally identical to that of the nonmagnetic field case. Author

N63-13489 Princeton U. Plasma Physics Lab., N.J.

MEASUREMENT OF THE THERMOELECTRIC POWER OF A FULLY-IONIZED, LOW TEMPERATURE PLASMA

N. Rynn Feb. 1963 10 p 4 refs
(Contract AT(30-1)-1238)
(MATT-174)

The Seebeck coefficient, or the thermoelectric power, of an alkali-metal plasma is measured from experimental data and compared with calculations based upon an approximate theory. The plasma is generated by allowing a collimated beam of alkali-metal neutrals to impinge upon a hot tungsten plate. As a check on experimental conditions after the measurements were taken, the plasma density was varied while plate temperatures were held constant. The slope of the straight lines fitted to the experimental points give a value of 3.81×10^{-3} volts/degree, for a ratio of measured to calculated values of 1.78. This is as good an agreement as one could expect because of the approximations made in the theory. The value obtained from the experiment also compares favorably with the value of 2.06×10^{-3} volts/degree calculated using the approximate theory. J.R.C.

N63-13504 Princeton U. Plasma Physics Lab., N.J.

A CONVERGENT CLASSICAL KINETIC EQUATION FOR A PLASMA

E. A. Frieman and D. L. Book Dec. 1, 1962 28 p 15 refs
(Contract AT(30-1)-1238)
(MATT-158)

A kinetic equation for a plasma of electrons and infinite mass ions is derived which exhibits no divergences for any impact parameter. The basic expansion used is in $n\lambda_D^3$, the number of particles in a Debye sphere. The collision operator has Boltzmann, Fokker-Planck, and Lenard-Balescu behavior in the appropriate impact-parameter regimes. Author

N63-13557 Republic Aviation Corp., Farmingdale, N.Y.

DESIGN OF SPIN RELAXATION-TIME EXPERIMENTS IN WEAK MAGNETIC FIELDS

A. Grumet Dec. 3, 1962 32 p 6 refs Prepared for First Annual Symp. on Unconventional Inertial Sensors
(RAC-1054; SRS-P-62-328)

Investigation is made of experimental arrangements for the measurement of relaxation times of liquid solutions in weak magnetic fields. Optimum coil sizes, field homogeneities, magnitudes of a.c. and d.c. magnetic fields are determined for maximum signal-to-noise ratios in the test-set receiver. The interdependence of parameters is derived. Practical circuitry is discussed. It is stated that, by calibration against a known solution, the text-set may be used to measure magnetic susceptibility. Only nuclear magnetic moments are considered. Author

N63-13559 General Electric Co. Space Sciences Lab., Philadelphia, Pa.

THE TRANSIENT INTERACTION OF A TRANSVERSE MAGNETIC FIELD WITH FLUID IN COUETTE FLOW

F. H. Shair Feb. 1963 61 p
(Contract AF 49(638)-1092)
(R63SD16)

Solutions are given to MHD couette-flow systems with increasing complexity, and the problem of Couette flow with an oscillating transverse magnetic field is solved. The solution is obtained by means of a transformation which demonstrates the similarity between a set of transient MHD systems and a set of transient heat-conduction systems. Under various conditions, the solution of the oscillating MHD system reduces to various solutions of simpler systems. Although the couette-flow system was chosen for simplicity, the results of this analysis are useful for the determination of : (1) the start-up time interval for both MHD-a.c. and MHD-d.c. systems, and (2) the steady-state distortion in the alternating current output for MHD-a.c. systems.
Author

N63-13643 Chalmers U. of Tech. Research Lab. of Electronics, Goteburg (Sweden)

DYNAMIC NON-LINEAR WAVE PROPAGATION IN IONIZED MEDIA. 7. NON-LINEAR PLASMA WAVES IN A STREAMING HOMOGENEOUS, COLD IONIZED MEDIUM

O. E. H. Rydbeck 1962 42 p 28 refs
(Contract AF 61(052)-451 and AF 61(052)-594)
(Res. Rept. 33; US-32; AFCRL-63-31)

The research reported deals with the properties of nonlinear traveling and standing plasma waves in homogeneous, ionized cold streams. For the traveling nonlinear plasma waves it is possible to obtain direct and simple expressions (provided electronic overtaking does not occur), which relate the charge density to the true stream coordinate. This direct method is not, in general, applicable to the practically important case of standing plasma waves—a symmetric space charge wave pair in the linear theory. There exists one exception, however, when the direct method can be applied to standing plasma waves, viz., the very special case of stream plasma resonance. The nonlinear maximum charge peaks, or charge bunches, are shown to be rather similar for the, physically otherwise quite different, traveling and standing nonlinear waves. Both rapidly become very rich in harmonics as overtaking is approached. Author

N63-13668 Los Alamos Scientific Lab., N. Mex.

A STUDY OF THE STABILITY OF A RELATIVISTIC PARTICLE BEAM PASSING THROUGH A PLASMA

R. C. Mjolsness Mar. 4, 1963 235 p 55 refs
(Contract W-7405-ENG-36)
(LA-2802) OTS: $3.00

The dispersion law is derived for small amplitude disturbances of the spatially nonuniform steady-state configuration of a relativistic particle beam of finite cross section and infinite length passing through a low temperature dense plasma. First, a macroscopic analysis is given in which Maxwell's equations are supplemented by fluid equations for the beam, and plasma effects are accounted for by means of a scalar conductivity. A more realistic treatment of the plasma is then obtained by introducing a variable tensor conductivity and appropriate boundary conditions, permitting the effects of Hall currents, density and temperature gradients, and metal walls to be assessed. Finally, the analysis is refined by treating the beam particles by means of the collisionless Boltzmann equation while maintaining the scalar conductivity description of the plasma. Use of the orbit integral technique for solving the Boltzmann equation permits the perturbed beam current to be expressed as an integral over the perturbed field variables, and the relativistic dynamics and the geometry of the configuration greatly increase the tractability of the expressions. Introduction of appropriate Hankel transforms of the field variables leads to an integral form for Maxwell's equations

and to the expression of the stability problem as a set of three linear, coupled integral equations. A formal solution of these equations is given, and the dispersion relation is seen to appear as a solvability condition for the equations. Asymptotic evaluations of the formal expressions are given for the case of low frequency, long wavelength disturbances, and high frequency, highly localized disturbances. Author

25 PHYSICS, SOLID-STATE

Includes: semiconductor theory; and masers.

For related information see: 09 Electronics; 23 Physics, General; and 24 Physics, Plasma.

N63-13346 Harvard U. Div. of Engineering and Applied Physics, Cambridge, Mass.

EFFECT OF PRESSURE ON THE ENERGY LEVELS OF IMPURITIES IN SEMICONDUCTORS Technical Report

Dec. 1962 29 p 55 refs Contains reprints from Phys. Rev., Oct. 1, 1962

(Contract Nonr-1866(10))

(HP-8)

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N63-13347 Harvard U. Div. of Engineering and Applied Physics, Cambridge, Mass.

ARSENIC, INDIUM, AND ALUMINUM IN SILICON

M. G. Holland (Ph. D. Thesis) and William Paul *In its* Effect of Pressure on the Energy Levels of Impurities in Semiconductors Repr. from Phys. Rev., v. 128, no. 1, Oct. 1, 1962 p 30-38 22 refs (See N63-13346 08-25)

The changes in resistivity of silicon samples containing group III and group V impurities have been measured at hydrostatic pressures up to 6000 kg cm^{-2} at 50° K. The changes are explained by a dependence on pressure of the ionization energy of the majority impurity center. The results indicate that the arsenic energy level moves toward the conduction-band edge at a rate of approximately 5×10^{-8} ev kg^{-1} cm^2. The energy levels for indium and aluminum move away from the valence-band edge at rates of about 5×10^{-8} ev kg^{-1} cm^2 and 1×10^{-8} ev kg^{-1} cm^2, respectively. Corrections for the changes in mobility with pressure have been applied for the n-type sample. The motion of the arsenic energy level is explained by a change in dielectric constant and effective mass with pressure, and indicates a change in the average effective mass of less than 1% in 5000 kg cm^{-2}. The very small changes in ionization energy, while expected, are to be contrasted with the much larger changes found for the deep-lying levels produced by elements such as gold. Author

N63-13348 Harvard U. Div. of Engineering and Applied Physics, Cambridge, Mass.

GOLD IN SILICON

Marshall I. Nathan and William Paul *In its* Effect of Pressure on the Energy Levels of Impurities in Semiconductors Repr. from Phys. Rev., v. 128, no. 1, Oct. 1, 1962 p 38-42 14 refs (See N63-13346 08-25)

The changes in resistivity of silicon samples containing gold impurity, which are appropriately counter-doped with hydrogenic impurities, have been measured at hydrostatic pressures up to 30,000 kg cm^{-2} near room temperature. The changes are explained by a dependence on pressure of the ionization energy of the gold impurity. The pressure coefficient of the energy of a gold acceptor level near the center of the forbidden gap has been determined, relative to both band edges; the coefficient of the separation from the conduction band edge is twice that of the separation from the valence band. The sum of the two coefficients gives a pressure coefficient for the total energy gap of -1.5×10^{-6} ev kg^{-1} cm^2 between 0 and 4000 kg cm^{-2} or -2.4×10^{-6} ev kg^{-1} cm^2 near 20,000 kg cm^{-2}. The low-pressure value is in agreement with previous, more direct determinations. A donar level due to the gold, roughly 0.35 ev above the valence band edge, has a very low pressure coefficient relative to that edge. Author

N63-13349 Harvard U. Div. of Engineering and Applied Physics, Cambridge, Mass.

GOLD IN GERMANIUM

M. G. Holland and William Paul *In its* Effect of Pressure on the Energy Levels of Impurities in Semiconductors Repr. from Phys. Rev., v. 128, no. 1, Oct. 1, 1962 p 43-55 19 refs (See N63-13346 08-25)

Gold can exist in substitutional positions in germanium in four states of ionization, with which are associated four energy levels in the forbidden energy gap. Appropriate doping and counterdoping with group V and group III elements allow each level to ionize independently of the others in certain temperature ranges. The separation in energy of the level from the band edges can thus be found. The pressure dependence of these separations can also be determined from the effect of the resultant change in carrier density on the resistivity. The measurements were carried out up to 6000 kg cm^{-2} between 45 and 273° K. Equations for analyzing the multienergy level systems are developed, and calculations indicating how these equations can be used in actual situations are included in a set of appendices. Corrections for the effects of changes in mobility and density-of-states on the resistivity are also considered. The results indicate that the pressure coefficients of all four levels are much greater than for the hydrogenic impurities, and that the separation from the conduction band increases much more rapidly than that from the valence band. Author

N63-13422 Johns Hopkins U. Carlyle Barton Lab., Baltimore

PARAMAGNETIC RELAXATION IN DILUTE POTASSIUM FERRICYANIDE

Andreas Rannestad Dec. 1962 126 p 49 refs

(Contract AF 33(616)-6753)

(AF-99)

The paramagnetic relaxation times for the ground-state Kramers doublet of iron present as a dilute substitutional impurity in potassium cobalticyanide have been measured for iron concentrations from 0.24% to 3.5%, over the temperature range 1.25° K to 4.5° K. Measurements were performed at 1.8 Gc/s and at 8.5 Gc/s. The Fast Passage-Recovery method was used for the measurements, and a description of the microwave spectrometers and associated equipment is included. A review of the relevant crystal field theory is given and includes a calculation of the energy levels for the three lowest Kramers doublets. The theory of spin-lattice relaxation is reviewed and compared with the experimental findings. Author

N63-13429 Cornell U. Lab. of Atomic and Solid State Physics, Ithaca, N. Y.

THERMODYNAMIC BEHAVIOUR OF THE HEISENBERG FERROMAGNET

F. Englert, R. Brout (Universite Libre de Bruxelles), R. B. Stinchcombs, and G. Horwitz Sept. 1962 81 p 24 refs

(Partially supported by ONR)

A finite temperature perturbation theory is presented for the Heisenberg model with the object of providing a formalism in which contact can be made with the low-temperature treatment by Dyson, the random phase approximation of Englert, and, above the Curie point, with high-density treatments of the Ising model. A linked cluster expansion is set up and a simple high-density classification, valid above the Curie point, is applied. The first two terms in the high-density series, tree graphs and ring graphs, yield molecular field theory and a form reducing to spin wave results at low temperatures. A low-temperature classification is then developed which leads to an expansion of the free energy in powers of T in which the terms have the form of those describing bosons with an effective interaction similar to Dyson's interaction. The first two terms are the low-temperature approximations of trees and rings, respectively, which justify the use of the high-density expansion below the Curie point. The next term, including all the effects of spin wave interaction up to T^4 in the free energy, contains the Born approximation series presented by Dyson. In particular, the cancellation of T^3 terms in the leading Born approximation is demonstrated. A renormalized version of the high-density expansion necessary to treat the region of the Curie point is then considered, and its approximation by an "excluded volume" sum is shown to yield the Curie point of the spherical model, in common with the random phase approximation and with high-density approximations to the Ising model. The extent to which the high-density theory misrepresents the effect of spin wave interactions is then discussed. An equations-of-motion approach to the random phase approximation and to the interactions between spin waves is presented. Author

N63-13467 Cornell U. Lab. of Atomic and Solid State Physics, Ithaca, N.Y.

INFLUENCE OF LOCALIZED MODES ON THERMAL CONDUCTIVITY

Max Wagner Jan. 1963 53 p 37 refs Submitted for Publication

(Supported by ONR)

The curves of the thermal conductivity vs. temperature of some insulating crystals (alkali halides) which are doped with certain impurity centers, exhibit a distinct indentation. This suggests an additional new relaxation time of some resonance nature, which is independent of the temperature for molecular impurity centers ($KCl:KNO_2$) and temperature dependent for monatomic disturbances (KCl:NaCl, etc.). A theory is given for the influence of inelastic scattering of phonons at localized modes outside the band and at quasi-localized modes inside. It is shown that in the case of monatomic defects there is no second-order scattering. The calculated relaxation time for the third-order process $(\underset{\sim}{k}\lambda) + (\underset{\sim}{k}'\lambda') \rightleftharpoons (s)$, describing phonons and localized quanta, respectively, has been tested on the experimental data in a preceding paper from the excellent agreement one may conclude that the indentation effect is quantitatively due to this scattering process. The analysis is also done for the scattering of phonons by internal modes of molecular perturbations. The relaxation time for the second-order process $(\underset{\sim}{k}\lambda) \rightleftharpoons (\beta)$, (β) = internal quantum, is independent of temperature and of resonance form as observed for $KCl:KNO_2$. Author

N63-13468 Michigan U., Ann Arbor

PRINCIPLES OF p-n JUNCTION DETECTORS

Gordon M. Brown, Alan F. Clark, and Philip R. Pluta Repr. from AM. J. Phys., v. 31, no. 1, Jan. 1963 p 19-25 7 refs

(NASA Grant NsG-115-61)

Elementary band theory and impurity concentration effects are reviewed in order to derive the basic relations for barrier-layer width and electrostatic potential as a function of applied reverse bias. Use of the solid-state ionization detector in the laboratory curriculum is indicated with sample lab experiments. Author

N63-13507 General Electric Co. General Engineering Lab., Schenectady, N.Y.

SEMICONDUCTING COMPOUNDS FOR THERMOELECTRIC POWER GENERATION [May 1960 to September 1962]

Ted Dietze, R. Vought, R. Bobone, and L. Kendall Fort Eustis, Va., Army Transportation Research Command, Feb. 1963 35 p 23 refs

(Contract DA-44-177-TC-639)

(TCREC-TR-112)

Several compounds with group I, IV, and VI elements having the formula $I_2IV\ VI_3$ were synthesized and evaluated. Several of these are unstable, perhaps because of improperly matched ionic radii. Two of these compounds, Cu_2SnS_3 and Cu_2GeS_3, appear to merit further study. Attempts to produce sound samples of I III IV compounds yielded generally inhomogeneous, metallic specimens. Alloying of Mg_2Sn with Mg_2Ge was shown to decrease the thermal conductivity. It was also observed that there is an n-to-p coversion of the alloy as the Sn/Ge ratio decreases. This conversion, the thermal conductivity decrease with alloying, and the effects of doping in these materials require further investigation. Experience with the Kohlrausch apparatus has shown that it is very useful for measuring thermoelectric properties at temperatures up to about 200° C. At higher temperatures, various types of thermocouple error make reliable measurements very difficult. Author

N63-13547 Case Inst. of Tech., Cleveland, Ohio

MAGNETORESISTANCE AND HALL EFFECT IN SINGLE CRYSTALS OF ALUMINUM

R. W. Stark and T. G. Eck Jan. 1963 23 p 13 refs

(Contract AF 49(638)-621)

(AFOSR-951)

The transverse magnetoresistance and Hall effect in aluminum have been investigated for several single crystals of high purity up to magnetic field strengths of 20,000 gauss. For magnetic fields above a few kilogauss, the Hall field is a linear, isotropic function of the magnetic field strength. The transverse magnetoresistance is reasonably isotropic and tends to saturate for all the current and magnetic field directions for which data were obtained. The general features of our results are in good agreement with those predicted from the model of the Fermi surface of aluminum based on Harrison's band calculation. Author

N63-13682 Laboratoire Central des Industries Electriques (France)

PHOTO-MAGNETO-ELECTRIC EFFECT IN GRADED-GAP SEMICONDUCTORS Final Report, 1 April 1960-30 April 1962

A. Fortini [1962] 22 p 26 refs

(Contract AF 61(052)-408)

(AFCRL-63-226)

A detailed calculation of the photomagnetoelectric effect in germanium semiconductors, which calculation takes into account the drifting effect of a gap-gradient on the electron-hole pairs, was conducted with the assumption of uniform mobilities. Results indicate that: (1) Axisymmetrical dependent mobilities induce second-order effects only. (2) The introduction of further refinements—such as strain-dependence of the local effective mass, the relative importance of longitudinal and transverse mobilities, and the ionization energies of impurities—is possible in intrinsic and heavily doped cases. (3) Resulting errors are consistent with previous values for the pressure dependence of the energy-gap in germanium. I.v.L.

N63-13695 Lockheed Missiles and Space Co., Sunnyvale, Calif.

SOLID STATE PROPERTIES OF BISMUTH AND TELLURIUM ALLOYS AND COMPOUNDS: AN ANNOTATED BIBLIOGRAPHY

P. R. Stromer, comp. Feb. 1963 68 p 133 refs

(Special Bibliography SB-62-62; Rept. 6-90-62-12)

A bibliography has been compiled from the recent (1961-1962) literature encompassing the solid-state properties of bismuth and

tellurium, both pure and in combination with each other and related substances. Abstracts are arranged alphabetically, and a detailed subject index is provided. Binary and ternary alloys are indexed under one term only, e.g., Bismuth-Antimony not Antimony-Bismuth. Author

N63-13700 Clarendon Lab., U. of Oxford (Gt. Brit.)
THE RAISING OF ANGULAR MOMENTUM DEGENERACY OF f-ELECTRON TERMS BY CUBIC CRYSTAL FIELDS
K. R. Lea, M. J. M. Leask, and W. P. Wolf Jan. 1962 30 p 14 refs
(Contract AF 61(052)-125)
(AFCRL-62-929)

The effect of a cubic crystal field Hamiltonian, containing both fourth- and sixth-degree terms and acting on an angular momentum J, has been investigated as a function of the ratio between the fourth- and sixth-degree terms. Tables of eigenvectors and diagrams of eigenvalues, expressed as a function of a mixing parameter, are given for all J-manifolds between 2 and 8 in half-integral steps. The application of the results to the magnetic properties of rare earth ions in cubic environments is discussed. Author

N63-13754 Ohio State U. Research Foundation. Antenna Lab., Columbus
MEASUREMENT OF THE PROPERTIES OF LASER CRYSTALS AT SUBMILLIMETER WAVELENGTHS
R. F. Rowntree and W. S. C. Chang Dec. 31, 1962 34 p 37 refs
(NASA Grant NsG-74-60)
(Rept. 1093-11) OTS: $3.60 ph, $1.22 mf

Since many crystals have strong lattice absorption bands in the far-infrared, one of the most important steps in developing a submillimeter maser is to measure the dielectric properties of laser materials; this determines their effect on possible laser operation. A description is given of the measurement of the optical constants of these laser materials in the wavelength range from 100μ to 1 mm by means of a special far-infrared spectrometer using an interferometric modulator as the "order sorter." The index of refraction and the absorption coefficient at 300° K and 90° K of the single-crystal materials such as $CaWO_4$ and MgO are presented. Rough experimental data on the other crystals such as Al_2O_3 and CaF_2 are discussed briefly. Author

26 PROPELLANTS AND COMBUSTION

Includes: fuels; igniters; and oxidizers.

For related information see: 07 Chemistry; and 27 Propulsion.

N63-13462 Texaco Experiment Inc., Richmond, Va.
COMBUSTION OF ELEMENTAL BORON Quarterly Summary Report, Aug.-Oct. 1962
U. V. Henderson, Jr., Harry P. Woods, and Genevieve M. Poplin Nov. 1, 1962 12 p 5 refs
(Contract Nonr-1883(00))
(EXP-223; TM-1384)

The study of the reaction between rods of single-crystal boron and fluorine gas has been continued in the low-pressure microbalance apparatus. Attempts to reproduce previous results with better control of the reaction temperature and pressure have been unsuccessful, with the observed rates being about one-third of those previously reported. Photomicrographs of the boron rod after exposure to fluorine gas indicate that the initial reaction occurs at selected sites to form hemispherical craters followed by reaction along lines extending from these craters. A detectable weight loss (approximately 0.05 mg/sec) does not occur until after the craters are formed. Author

N63-13497 General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.
ANALYTICAL STUDIES OF TRANSIENT EFFECTS IN FAST REACTOR FUELS—I
R. B. Osborn and D. B. Sherer AEC Div. of Tech. Inform., Aug. 1962 56 p 31 refs
(Contract AT(04-3)-189)
(GEAP-4058) OTS: $1.25

An experimental program to evaluate the performance of FCR and EFCR fuel during transient operation is outlined, and possible mechanisms of failure are analyzed. This analysis has involved evaluation of temperature levels and gradients, fuel-element internal pressure, differential thermal expansion in various parts of the fuel, and the resultant deformation that may occur in either normal operating transients or accidental power excursions. With a NaK coolant, the mechanism for transient fuel failure in EFCR is likely to be coolant boiling unless severe local stress concentrations exist. With a sodium coolant, in either EFCR or FCR, the failure mechanism is more likely to be internal pressure due to fission gas and/or fuel vapor pressure and is thus directly dependent on fuel temperatures. Author

N63-13523 Little (Arthur D.) Inc., Cambridge, Mass.
DEVELOPMENT OF AN EXPLOSIVE SYSTEM FOR ACCELERATING A METAL PELLET Final Report
Wendell G. Sykes and Edward A. Vrablik Jan. 30, 1963 18 p
(Contract AF 19(604)-7480)
(AFCRL-63-246)

An explosive system capable of accelerating a 2.2-gram nickel-iron pellet to a velocity of 4.2 km/sec. was developed, tested, and used as the final stage of a multistage rocket in an experiment to observe the light emitted from an artificial nickel-iron meteorite of known mass. Author

N63-13566 Thiokol Chemical Corp., Elkton, Md.
A RESEARCH STUDY TO ADVANCE THE STATE-OF-THE-ART OF SOLID PROPELLANT GRAIN DESIGN Quarterly Progress Report No. 2, October 1, 1962 to January 1, 1963
Mary Pase et al Mar. 8, 1963 67 p 12 refs
(Contract AF 33(616)-6530, Suppl. 6)
(E13-63)

This is a research study to advance the state-of-the-art of solid-propellant grain design and consists primarily of theoretical and applied analyses of solid-propellant grain designs, considering in particular heat-transfer effects, propellant slump, and the effect of strain on burning rate. A review of the original finite-difference equations was made, and several revisions were made to permit added versatility. The ability to consider time-dependent boundary conditions including a known external heat flux, aside from convection and radiation, has been developed. Flow charts were constructed and programing effort was undertaken. A method for analyzing the effect of a nonuniform grain temperature profile, resulting from nonuniform external heating, on the surface regression of a solid-propellant rocket was developed. Strand burner testing of TP-H-1050 under various degrees of strain has been completed and indicated no change in the linear burning rate due to strains up to 12 percent. A possible explanation based on volumetric changes for strain affecting the burning rate of some propellants, but not others, is discussed. An apparatus to measure changes of volume under strain has been assembled and is also discussed. A review and analysis of the problems associated with the "slump" of an upright propellant grain was completed. This consisted for the most part of an investigation of the

various approaches to the deformation of a circularly perforated grain under its own weight. The determination of an elastic solution for the slump in a long, hollow, circular cylinder, together with the selection of a convenient means of incorporating the time-dependent behavior into this solution, was accomplished. Author

N63-13595 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
ON THE MECHANISM OF BLUFF BODY FLAME STABILIZATION AT LOW VELOCITIES
T. Maxworthy Dec. 1962 Repr. from Combustion and Flame, Dec. 1962 p 233-244 16 refs
(NASA Contract NAS7-100)
(JPL-TR-32-183)

Bluff body laminar flame stabilization studies have shown, under a wide variety of circumstances, flame sheets that were wrinkled into 'nodal' waves with well-defined wavelengths and velocities of propagation. Experiments are described that explain the observed waveforms. It is believed that they are forced, unstable, propagating, interfacial waves, forcing being caused by the oscillation of the point of attachment of the flame in the boundary layer and wake surrounding the flameholder. Spark shadowgraphs are presented to support this conclusion. Data are presented to show the dependence of the frequency of oscillation of flow velocity, air/fuel ratio, and sphere diameter. Flameholding phenomena and the formation of "envelope" flames are also discussed. Author

N63-13605 Air Reduction Co., Inc. Central Research Labs., Murray Hill, N. J.
ADVANCED TEST METHODS FOR DETERMINING OPERATIONAL CHARACTERISTICS OF PROPELLANTS Sixth Quarterly Progress Report, Sept. 1, 1962 to Nov. 30, 1962
G. A. Mead [1962] 23 p
(Contract AF 04(611)-7413)

Simultaneous streak photograph and electronic conductance probe measurements have been made on nitromethane and nitromethane sensitized with 3% ethylene diamine. Definition of data in the preignition region is not yet satisfactory. Attempts to detect passage of the detonation front by spaced Teflon sleeves on the conductance probes were unsuccessful, probably because the Teflon became conductive under the conditions of the test. A remote loading system and cold-gas sample refrigeration system have been installed and tested for use with liquids having high vapor pressure. Modification of the U-tube compression test has resulted in some positive results on nitromethane, but these were not reproducible. Pressure calibration tests with inert liquids gave traces with the expected characteristics, but valve operation may have been erratic. In the batch-type thermal stability test, two new bomb designs have been tried with the intent of reducing the resistance to heat transfer between the sample and the heating bath. Results were obtained on nitromethane, nitromethane sensitized with 3% ethylene diamine, n-propyl nitrate, and monomethyl hydrazine. A remote loading system was assembled. In the first test with acetylene, explosion occurred at about 540° F, demolishing the bath. Author

N63-13606 Argonne National Lab., Ill.
CALCULATIONS FOR ZPR-VII UNIFORM LATTICE CRITICAL EXPERIMENTS WITH THORIA-URANIA FUEL IN HEAVY WATER
E. M. Pennington Dec. 1962 58 p 33 refs
(Contract W-31-109-eng-38)
(ANL-6661)

Calculations are reported relating to the uniform lattice critical experiments performed in the ZPR-VII critical assembly with THUD or Babcock and Wilcox thoria-urania fuel and heavy water as moderator. Constants appearing in the criticality equation and material bucklings were computed for lattice pitches used in the experiments. Reflector savings were calculated and used in conjunction with experimental critical dimensions to calculate geometric bucklings. Analyses were carried out for various experiments, such as measurements of U^{235} and thorium-cadmium ratios, water worth, and fuel-substitution experiments. Theoretical and experimental values are compared whenever possible. Author

N63-13612 California U., Livermore. Lawrence Radiation Lab.
FISSION DISTRIBUTION IN SEVEN-PIN CLUSTER FUEL ELEMENTS
Robert Gordon Sept. 1962 222 p 37 refs
(Contract W-7405-eng-48)
(UCRL-6695) OTS: $3.00

The distribution of fissions within one fuel pin of a cluster is asymmetrical because of self-shielding and neutron streaming phenomena. An implicit solution of the integral form of the Boltzmann equation indicates that, for a given neutron spectrum, this distribution is primarily a function of three dimensionless parameters: (1) pin radius/neutron mean free path in pin material, (2) pin circle radius/pin radius, and (3) pin radius/fuel element radius. The actual distribution was determined experimentally by detector foils and autoradiographic techniques for various seven pin, cluster type, gas-cooled fuel elements. The experimental fuel pins were fabricated by winding alternate 0.001-inch-thick layers of pure aluminum and enriched uranium (93% U^{235}) on a solid core until the desired pin diameter was reached. Seven of these pins, assembled into a fuel element, were irradiated in the thermal column of a research reactor. The layers of uranium and the uranium detector foils (which had been exposed concurrently) were subsequently autoradiographed and the resulting X-ray film optical density measured on a microdensitometer. The detector foils were also counted in a gamma detector, thus providing a key between relative radioactivity and optical density. It was found that the fission distribution within the center pin of the cluster was symmetrical, and that the fission distribution in the outer pins of the cluster was asymmetrical with respect to the pin center. Author

N63-13670 National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
NASA RESEARCH ON RESISTANCE-HEATED HYDROGEN JETS [Status Report No. 3]
John R. Jack and Ernie W. Spisz Mar. 1963 19 p 3 refs Presented at the AIAA Electric Propulsion Conf., Colorado Springs, Mar. 11-13, 1963

The resistance heating approach for generating high-temperature gases is being investigated for possible application to electric propulsion systems. The design concept under consideration uses an electrically heated tungsten heat exchanger (tube or wire) to achieve hydrogen propellant temperatures of the order of 5500° R. Thrustors of this design (tube or wire) were tested over an input power range of 0 to 38 kilowatts for propellant flow rates of 10^{-3} lb/sec. With the tube heat-exchanger unit (water-cooled) operating at an input power of 30 kw, a specific impulse of 700 seconds was achieved with an overall thrustor efficiency of 36 percent. For the wire-coil unit (radiation cooled) with an input power of 15 kw, a specific impulse of 710 seconds with an efficiency of 73 percent was attained. Future designs are expected to attain a specific impulse of 1000 seconds with an efficiency of 75 percent or better. R.C.M.

N63-13768 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
THE EFFECTS OF MOISTURE ON THE DYNAMIC MECHANICAL PROPERTIES ON AMMONIUM PERCHLORATE—POLYURETHANE PROPELLANTS
Robert F. Landel and B. G. Moser Feb. 26, 1963 22 p 8 refs
(NASA Contract NAS7-100)
(JPL-TR-32-389) OTS: $2.60 ph, $0.86 mf

The detrimental effect of moisture on ammonium perchlorate—polyurethane propellant appears to be due to one or more of the following mechanisms: solution, migration, and precipitation of the

oxidizer. Direct microscopic observation indicates that the ammonium perchlorate grains are physically separated from the binder, when exposed to relative humidities greater than 15% at ambient temperatures. This physical dewetting leads to small-strain dynamic shear compliance instability which is a function of time and environment. The environmental effect, producing either a softening or an embrittlement, is established to be a function of the previous humidity history and the environment at the time of measurement. There appears to be an optimum amount of water necessary for maximum embrittlement at any given temperature, and additional water tends to decrease embrittlement. The detrimental effects can be reversed, apparently by a healing of the salt-binder adhesion on the surface of the initial grains, and additional reinforcement provided by the precipitation of new, euhedral crystals of ammonium perchlorate. Author

27 PROPULSION

Includes: airbreathing, electric, liquid, nuclear, and solid propulsion.

For related information see: 04 Aircraft; 06 Auxiliary Systems; 26 Propellants and Combustion; and 30 Space Vehicles.

N63-13383 Diamond Ordnance Fuze Labs., Washington, D.C.
FLUID AMPLIFIER DEMONSTRATION VEHICLE
R. Richard Palmisano *In its* Proc. of the Fluid Amplification Symp., Vol. I, Oct. 2-4, 1962 Nov. 15, 1962 p 27-36 (See N63-13380 08-11)

A jet-propelled vehicle has been built which demonstrates the practicality of fluid-amplification for thrust vectoring. An account is also given of a 5-stage proportional fluid amplifier which is capable of amplifying control signals over 100,000 times. The amplifier output is used to steer the vehicle by deflecting the propelling jet stream. Both propulsion and steering of the vehicle are achieved without the use of mechanical linkage. Author

N63-13572 National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
AN ELECTROSTATIC PROPULSION SYSTEM WITH A DIRECT NUCLEAR ELECTROGENERATOR
Charles A. Low, Jr., and William R. Mickelsen N.Y., Inst. of the Aerospace Sci., 1962 Repr. from Aerospace Eng., v. 21, no. 12, Dec. 1962 p 58-87 28 refs Previously processed as a preprint; N62-12478 08-26

A direct nuclear electrostatic propulsion system is discussed as to theoretical feasibility and to provide an estimate of the possible mass/power ratio of the overall system. Mechanics of such a system are described for two types of particles: (charged) fission fragments and beta particles. This type of propulsion system, in theory, could be used in combination with an electrostatic rocket engine to form a high-performance system for spaceflight. Two such integrated propulsion systems are discussed: an electrogenerator using an alpha (He^{++}) emitting radioisotope and an electrogenerator using a beta negative (β^-) emitting radioisotope. As a fuel source, radioisotope emitters prepared on ground before the mission appear to be the only type competitive as to weight/unit power with the conventional nuclear reactor using a thermal cycle system. Design requirements for two possible missions to Mars, using the direct nuclear electrostatic propulsion system principles, are described. The overall system is theoretically capable of making very fast interplanetary flights, with payloads substantially greater than other electric propulsion systems currently proposed or under development. A.R.B.

N63-13579 National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
NUCLEAR ROCKETS FOR UNMANNED MISSIONS
Frank E. Rom, Armin F. Lietzke, and Paul G. Johnson Repr. from Nucleonics, v. 20, no. 11, Nov. 1962 p 53-37 9 refs

Small nuclear stages, rather than chemical rockets of any size, are suggested to carry out unmanned missions, particularly pioneering space probe missions and unmanned scientific exploration of space beyond the reach or capability of manned vehicles. The velocity increments required for a wide variety of unmanned missions are given. The data indicate that many probe missions and planetary round trips require high-velocity increments—too high for an all-chemical system, such as the Atlas-Centaur or Nova. On the other hand, small nuclear stages, as low as 4.5 tons in weight and 10 mw in power, can be launched from low-lying orbits to carry out missions requiring these high-velocity increments. Even for booster systems that contain a nuclear stage, it will always pay to add a final nuclear stage using a lightweight powerplant. A comparison of nuclear powerplants shows that a water-moderated reactor with a W^{184} core structure offers the best potential as a powerplant for the final nuclear stage. B.J.C.

N63-13731 Lyon Inc., Detroit, Mich.
DEVELOPMENT OF DEEP DRAWN—ONE PIECE HIGH PERFORMANCE ROCKET MOTOR CASE General Report No. 21 for the Period June 30 through Sept. 30, 1962
Wayne A. Martin Sept. 30, 1962 90 p
(Contract DA-20-018-ORD-23004)

Development work on the 40-in. rocket motor case is reported as follows: hydrostatic testing of Phase I case; third cold draw of cases from Ladish D-6AC steel and ALSI 1010 steel; testing of Republic 4350 steel; and special tooling and die assemblies for Phase II cases. R.C.M.

N63-13757 Aerojet-General Nucleonics, San Ramon, Calif.
INVESTIGATION OF ELECTRODELESS PULSED PLASMA PROPULSION [Final] Technical Documentary Report [July 1961-Nov. 1962]
J. S. Luce, D. C. Gates, W. B. Day, J. F. Detko, O. D. Johns, and J. L. Wyatt Wright-Patterson AFB, Ohio, Propulsion Lab., Feb. 1963 137 p 11 refs
(Contract AF 33(616)-8331)
(AGN-AN-759; ASD-TDR-62-1105)

This report is a summary of the principal results of a seventeen-month research program for the analytical and experimental investigation of electrodeless plasma accelerators as space propulsion devices. Measurements were made of the velocity, density, and conductivity of the plasma produced by a button source to be used with the transmission line. Diagnostic equipment was constructed for the measurement of plasma velocity, density, temperature, and conductivity. The button-type sources studied proved suitable for injecting into a transmission line and capable of producing a copper plasma with densities up to 10^{15}/cc and velocities in the neighborhood of 2×10^4 m/sec. Conductivities were in the range of 1000 to 15000 mho/m. Among the principal results of the studies of the interaction of this plasma with the transmission line was the preferential trapping of plasma on the leading portion of the traveling cusp. This result was in sharp contrast to the ineffectiveness of the trailing half of the cusp to retain and accelerate the plasma. These findings support a flux-trapping concept which was devised to improve the field-plasma interaction, containment, and disengagement of the plasma from the traveling field at the end of the transmission line. Also, there was

found direct evidence for the presence of circulating Hall currents in the accelerator. There is strong evidence for the occurrence of a large-scale instability which developed in the reflected wave. Author

N63-13759 Naval Ordnance Test Station, China Lake, Calif.
FEASIBILITY STUDY AND DEMONSTRATION OF VARIABLE-THRUST PROPULSION FOR A SOFT-LANDING VEHICLE
Felton Williamson, Jr. Jan. 1963 28 p 3 refs
(NAVWEPS-7900; NOTS-TP-2901)

The soft-landing vehicle was designed and tested to demonstrate the feasibility of using the NOTS Variable Area Injector to softly land a rocket vehicle without the aid of aerodynamic forces. The vehicle was tested in a vertical track which restricted freedom of movement to the direction of the vertical axis. Propellant tank capacity of the soft-landing vehicle was 200 pounds of inhibited red fuming nitric acid and 100 pounds of unsymmetrical-dimethylhydrazine. Total loaded weight of the vehicle was 700 pounds and maximum thrust was 1,300 pounds. The vehicle successfully completed four captive flight tests. During these tests a maximum height of 155 feet and landing velocities between 3.8 and 8.3 feet per second were achieved. Thrust control was sufficient to allow the observer to hover the vehicle. Author

28 SPACE RADIATION

Includes: cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts.

For related information see: 05 Astronomy and Astrophysics; 16 Life Sciences; and 29 Space Sciences.

N63-13577 Sandia Corp., Albuquerque, N. Mex.
THE DISTRIBUTION OF ABSORBED X-RAY ENERGY IN THE ATMOSPHERE Research Report
Frank Biggs Feb. 1963 18 p 5 refs
(Sponsored by AEC)
(SC-4759(RR)) OTS: $0.50

An approximation is developed for calculating the distribution of absorbed X-ray energy in the upper atmosphere for the following two sources: (1) an isotropic point source above the atmosphere and (2) a plane beam of X-rays incident vertically downward on the atmosphere. The approximation neglects earth curvature. This result is then applied to black-body spectra of kT = 0.5 Kev, kT = 1.0 Kev, kT = 1.5 Kev, and kT = 2.0 Kev. Author

N63-13662 New Hampshire U., Durham
VARIATIONS IN THE COSMIC-RAY NUCLEONIC INTENSITY Final Report
J. A. Lockwood Jan. 1, 1963 117 p 65 refs
(Contract AF 19(604)-4552)
(AFCRL-63-242)

Investigations of the temporal variations of the cosmic-ray neutron intensity and of the neutron and charged particle intensities, measured at distances of 200 km to 500 km from the earth, include: (1) long-term or 11-year variation, (2) Forbush decreases, (3) 27-day recurrent tendencies, and (4) increases associated with solar flares. I.v.L.

N63-13671 Space Technology Labs., Inc. Quantum Physics Lab., Redondo Beach, Calif.
CONDUCTIVE HEATING OF THE SOLAR WIND, I
L. M. Noble and F. L. Scarf Mar. 1963 34 p 22 refs
(STL 9990-6382-RU-000)

The hydrodynamic equations for the solar corona, with no external heat source beyond a thin shell, are solved for the case of fast expansion. We assume that the corona is approximately 10% ionized helium, and that the Chapman value for the uninhibited thermal conductivity can be used everywhere. The equations are integrated from the earth to the sun on an IBM-7090 computer, and a power-series expansion is used in the neighborhood of the singularity at r_o, where $kT(r_o) = mv(r_o)^2$. We find that thermal conduction naturally supplies sufficient heating to accelerate particles to the observed solar-wind flux near the earth, if the inner coronal densities are near the accepted values, with a base temperature near 2×10^6 °K. The relation between this expansion and convective instability is discussed, and viscous and magnetic stabilization is examined. Author

N63-13715 National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
DELINEATION OF TRACKS OF HEAVY COSMIC RAYS AND NUCLEAR PROCESSES WITHIN LARGE SILVER CHLORIDE CRYSTALS
Lawrence M. Slifkin (North Carolina U.) and Charles B. Childs Washington, NASA, Mar. 1963 11 p 20 refs
(NASA TN D-1547) OTS: $0.50

Tracks of energetic charged particles, such as heavy primary cosmic rays and the products of nuclear collisions, have been made visible within the interior of large, transparent crystals of silver chloride. The tracks are delineated by photoelectric formation of metallic silver along them. This technique may be useful as a convenient and distortion-free method for the study of heavy primaries and fission fragments. Author

N63-13722 National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ENERGY SPECTRUM OF ELECTRONS IN THE OUTER RADIATION BELT
Wilmot N. Hess and John A. Poirier Washington, NASA, Mar. 1963 18 p 27 refs
(NASA TN D-1717) OTS: $0.50

The equilibrium energy spectrum of electrons in the outer radiation belt is determined by the injection spectrum and the loss processes that operate to remove the electrons or change their energy. The loss processes considered here are ionization energy loss, multiple scattering, and electron-electron scattering; the injection spectra considered are neutron β-decay electrons and monoenergetic electrons of 780 and 20 Kev. The problem is treated numerically. The results of the numerical calculation are compared with recent measurements of the outer-belt electron spectrum; it appears that neutron decays produce a reasonable fraction of the outer-belt electrons, but other processes such as acceleration may be important. Author

N63-13777 Academy of Sciences (USSR). Commission on the Study of the Sun, Moscow
SPECTROSCOPIC INVESTIGATION OF CORPUSCULAR EJECTIONS ON THE SUN (SPEKTROSKOPICHESKOE ISSLEDOVANIE KORPUSKULIARNYKH VYBROSOV NA SOLNTSE)
A. B. Severnyi *In its* The Physics of Solar Corpuscular Streams and Their Influence on the Upper Atmosphere of the Earth [1957] p 57-72 2 refs (See N63-13775 08-29)

Spectroscopic studies have been made of faculae to determine the mechanisms of corpuscular ejections from the sun. The H and K lines of ionized calcium and the H_α line were measured along with the fine structure of faculae emission. Spectrograms of the H and K lines indicated half-widths corresponding to a purely thermal Doppler

broadening. The extremes of the H_α line were shifted toward lower velocities as compared with the extremes for the K line. This could possibly indicate that the velocity of the Ca^+ ions is greater than the velocity of the hydrogen atoms. Good images of the fine structure of faculae emission (mustaches) were obtained and showed that the continuous and linear emissions are concentrated in individual "grains" no larger than a circle of scattering of 0.4" (~300). These mustaches are regarded as evidence of corpuscular streams that originate primarily at great depths below the reversing layer and that are ejected for short periods (sometimes of the order of several minutes). The data are considered as evidence of a nuclear explosion ejection mechanism. R.C.M.

N63-13778 Academy of Sciences (USSR). Commission on the Study of the Sun, Moscow

SOLAR CORPUSCULAR RADIATION AND THE TOPOLOGY OF THE MAGNETIC FIELD IN THE SOLAR CORONA (KORPUSKULIARNOE IZLUCHENIE SOLNTSA I TOPOLOGIIA MAGNITNOGA POLIA V SOLNECHNOI KORONE)

E. A. Ponomarev *In its* The Physics of Solar Corpuscular Streams and Their Influence on the Upper Atmosphere of the Earth |1957| p 73-80 9 refs (See N63-13775 08-29)

Formations observed in the solar corona are described and related to theories on the structure of the corona and the interaction of the magnetic field. The formations discussed include the aggregate of fine, slightly bent, rays in the polar regions of the corona (brushes), and the large coronal rays similar to onions (helmets or fans). R.C.M.

N63-13779 Academy of Sciences (USSR). Commission on the Study of the Sun, Moscow

DISCUSSIONS ON THE LECTURES OF E. R. MUSTEL', A. B. SEVERNYI, S. K. VSEKHSVIATSKII ET AL., G. M. NIKOLSKII AND E. A. PONOMAREV

K. P. Stanivkovich *In its* The Physics of Solar Corpuscular Streams and Their Influence on the Upper Atmosphere of the Earth |1957| p 81-93 (See N63-13775 08-29)

The physics of corpuscular streams and the mechanisms for their ejection are discussed. R.C.M.

N63-13780 Academy of Sciences (USSR). Commission on the Study of the Sun, Moscow

MAGNETIC DISTURBANCES IN THE REGION NEAR THE POLE AND THE EXISTENCE OF A SECOND ZONE OF THEIR INCREASED INTENSITY (MAGNITNYE VOZMUSCHCHENIIA V OKOLOPOLIUSNOI OBLASTI I SUSHCHESTVOVANIE VTORIE ZONY IKH POVYSHENNOI INTENSIVNOSTI)

A. P. Nikol'skii *In its* The Physics of Solar Corpuscular Streams and Their Influence on the Upper Atmosphere of the Earth |1957| p 94-111 (See N63-13775 08-29)

Recent data obtained on magnetic and ionospheric disturbances by the Soviet Arctic Institute are discussed and related to existing theories on the mechanisms of the solar corpuscle-ionosphere interaction. It is shown that the data can be best explained by the Birkeland-Störmer theory. R.C.M.

N63-13781 Academy of Sciences (USSR). Commission on the Study of the Sun, Moscow

THE CONNECTION BETWEEN SOLAR ACTIVITY AND GEOMAGNETIC DISTURBANCES (O SVIAZI MEZHDU SOLNECHNOI AKTIVNOST'IU I GEOMAGNITNYMI VOZMUSHCHENIIAMI)

A. I. Ol' *In its* The Physics of Solar Corpuscular Streams and Their Influence on the Upper Atmosphere of the Earth |1957| p 112-120 17 refs (See N63-13775 08-29)

Recent studies on the relationship of geomagnetic disturbances to solar activity are reviewed. The question of identifying M-regions on the sun's surface is discussed along with the possible causes of decreases in geomagnetic disturbances following sunspots which are devoid of radio emission. The necessity is shown for comparing geomagnetic disturbances on the basis of the type of commencement involved (sudden or gradual). R.C.M.

N63-13782 Academy of Sciences (USSR). Commission on the Study of the Sun, Moscow

DISCUSSIONS ON THE LECTURES BY A. O. BURDO AND A. I. Ol'

A. P. Nikol'skii, V. I. Krasovskii, and K. K. Fedchenko *In its* The Physics of Solar Corpuscular Streams and Their Influence on the Upper Atmosphere of the Earth |1957| p 121-125 (See N63-13775 08-29)

Lectures on the geographic distribution of magnetic disturbances are discussed along with those on the ionospheric effects of solar corpuscular radiation. R.C.M.

N63-13784 Academy of Sciences (USSR). Commission on the Study of the Sun, Moscow

THE EQUATION OF QUASISTATIONARY IONIZATION EQUILIBRIUM IN THE F2 REGION AND SOLAR CORPUSCULAR RADIATION (URAVNENIE KVASISTATSIONARNOGO IONIZATSIONNOGO RAVNOVESIIA V OBLASTI F2 I KORPUSKULIARNOE IZLUCHENIE SOLNTSA)

E. I. Mogilevskii *In its* The Physics of Solar Corpuscular Streams and Their Influence on the Upper Atmosphere of the Earth 1957 p 130-139 (See N63-13775 08-29)

A method is established for making a quantitative estimate of the ionizing role of corpuscular radiation on the ionosphere. Starting with the equation of ionospheric equilibrium for the F-2 region, an equation for quasi-stationary ionospheric equilibrium is derived whose solution can be confirmed by statistical ionospheric data. R.C.M.

29 SPACE SCIENCES

Includes: space chemistry; cosmology; lunar and planetary exploration; and theoretical analysis of orbits and trajectories.

For space biology see: 16 Life Sciences.

For related information see: 05 Astronomy and Astrophysics; 12 Geophysics; and 22 Navigation and Guidance.

N63-13352

REPORT ON THE ABNORMAL DISTURBANCES IN THE MOVEMENT OF THE SATELLITE 1960 IOTA 1 /ECHO-1/

Leon Wahlfeil |1962| 3 p

Echo 1's movements around the earth were observed and recorded for the period from August 24, 1960, to February 15, 1962. Over this period, the sidereal period of revolution, for the most part, diminished "irregularly" (daily or periodical variations in the diminishings) from the 118.3 minutes recorded on August 24, 1960. However, abnormal disturbances of variations in satellite movement were observed during February and March 1961: the sidereal revolution period of Echo I increased by as much as 3.2. During November to December 1961, increases in the sidereal period of revolution were also observed. Tables are given showing the variations in the sidereal revolution period from August 24, 1960, to February 15, 1962. B.J.C.

N63-13353
THE SATELLITIC PLANISPHERE
Roman Janiczek [1962] 7 p

A planisphere is described for determining a satellite's orbital elements, trajectory, or celestial position. The construction of the planisphere utilizes the dependence between the topocentric zenith distance z and the satellite's geocentric angular distance γ to the observation point. The device consists of a map of the sky in the equatorial system covered by three transparent disks. Two of the disks, containing the satellite's geocentric projection upon the celestial sphere and the horizontal coordinate grid, are joined to the map at the celestial pole. The third disk contains concentric circles of radius γ and its center is placed over z of the observation point. Other planispheres can be constructed for establishing the moments of eclipses or for use with satellites having circular orbits. R.C.M.

N63-13436 Rome Air Development Center. Space Defense Systems Lab., Griffiss AFB, N.Y.
A PRELIMINARY GUIDANCE ANALYSIS OF AN EARTH-MOON LIBRATION POINT VEHICLE
Anthony C. Diana Feb. 1963 24 p 3 refs
(RAL-TM-63-2)

To insure mission success for space missions of the lunar and libration-point variety, it will be necessary to provide some sort of enroute guidance. This report discusses guidance considerations and shows the effects of instrumentation errors on the accuracy in arriving at L_4. Major discussion concerns the effect of burnout errors and midcourse trajectory errors on the miss distance at L_4, in order to put bounds on the amount of error which can be tolerated in the guidance system needed to perform this mission. Author

N63-13448 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
A PRELIMINARY MODEL OF THE VENUS ATMOSPHERE
L. D. Kaplan Dec. 12, 1962 10 p 11 refs
(NASA Contract NAS7-100)
(JPL-TR-32-379) OTS: $1.10 ph, $0.80 mf

"Standard" and extreme model atmospheres of the planet Venus are calculated and presented, with temperature, density, and height given as functions of pressure, and with pressure, temperature, and density given as functions of height. Until more recent data are interpreted, the models are considered preliminary. Author

N63-13449 Jet Propulsion Lab. Calif. Inst. of Tech., Pasadena
RANGER PREFLIGHT SCIENCE ANALYSIS AND THE LUNAR PHOTOMETRIC MODEL
A. G. Herriman, H. W. Washburn, and D. E. Willingham Jan. 7, 1963 44 p 11 refs
(NASA Contract NAS7-100)
(JPL-TR-32-384) OTS: $4.60 ph, $1.52 mf

A photometric model of the lunar mare surface is presented. The lighting parameters for the Ranger 3, 4, and 5 TV system are developed using the photometric model, and related to the system parameters. The interactions of the TV constraints with those imposed by the other experiments and by trajectory characteristics are discussed in detail, and the use of plastic spheres to show graphically the interrelationships among the parameters is described. Author

N63-13486 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
EARTH-VENUS TRAJECTORIES, 1964, VOLUME 1, PART A
V. C. Clarke, Jr., R. Y. Roth, W. E. Bollman, T. W. Hamilton, and C. G. Pfeiffer Oct. 31, 1962 790 p 9 refs
(NASA Contract NAS7-100)
(JPL-TM-33-99) OTS: $31.00 ph, $23.90 mf

This volume is one of a set of five giving key characteristics of Earth-to-Venus trajectories during the period 1964 to 1970. This period is divided into five 120-day launch intervals spaced about 19.2 months apart. During each interval, trajectory characteristics are given for flight times of from 70 to 220 days in 2-day steps. R.C.M.

N63-13515 National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
A CONSIDERATION OF LUNAR SURFACE BALLISTICS AND THE HAZARDS ASSOCIATED WITH SPACECRAFT LANDING OR LAUNCH OPERATIONS
D. C. Cramblit Washington, NASA, Mar. 1963 33 p 14 refs
(NASA TN D-1526) OTS: $1.00

This preliminary study was directed specifically toward determination of the trajectories or flight paths of lunar-surface particles accelerated by the jet blast from a lunar-landing or return vehicle. A range of particle velocities was assumed based on an anticipated effective exhaust gas velocity of 13,250 ft/sec for a LOX-LH_2 engine. Thus, velocities both above and below those required for escape or orbit from the lunar surface were considered. Data are presented in graph and chart form, along with a brief discussion. Sample calculations and basic data for the ballistics study are presented. Author

N63-13531 Sterrewacht Sonnenbergh, Utrecht (Netherlands)
SATELLITE OBSERVATIONS IN THE NETHERLANDS Technical Report
C. de Jager Apr. 30, 1962 15 p 3 refs
(Contract AF 61(052)-396)
(*Its* Reprint 29)

At twenty observation posts in the Netherlands, satellites have been observed with a certain degree of regularity. At most posts, the observations have been made visually; later some stations turned to the photographic technique. A description is given of the computer programs which were developed to predict the apparent path of a satellite from its orbital elements, and also the program to compute the equatorial coordinates from the rectangular coordinates measured on a measuring machine. Author

N63-13596 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
MARINER 2 FLIGHT TO VENUS
F. L. Barnes, W. E. Bollman, D. W. Curkendall, and T. H. Thornton, Jr. Dec. 1962 Repr. from Astronautics, Dec. 1962 p 66-72 4 refs
(NASA Contract NAS7-100)
(JPL-TR-32-395)

An analysis of the Mariner 2 mission to Venus is presented as being fundamental for future deep space flights. Topics covered are: designing the trajectory to satisfy strict objectives and constraints, determining a statistical description of injection errors and the midcourse-correction capability needed to correct these errors, analyzing the effect of the midcourse maneuver on the trajectory errors at Venus, and developing the operational capability of tracking and executing the midcourse correction to maximize data return. A.R.B.

N63-13597 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
A CATALOG OF MICROSTRUCTURES OBSERVED IN CARBONACEOUS CHONDRITES
Gregg Mamikunian and Michael H. Briggs Mar. 15, 1963 79 p 20 refs
(NASA Contract NAS7-100)
(JPL-TR-32-398) OTS: $7.60 ph, $2.57 mf

A catalog of microphotographs is presented that give the microstructures observed in carbonaceous chondrites. An examination of the microphotographs demonstrates that all meteorite preparation used in this study contain a variety of microstructures in the circa 20-μ size range that exhibit an unusual morphology and yet are not readily identifiable. Identification of certain microstructures as various mineral crystals or contaminating terrestrial debris is made. J.R.C.

N63-13598 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
THE ROLE OF SOIL SCIENCE IN SPACE EXPLORATION
Roy E. Cameron Feb. 16, 1963 20 p 57 refs Presented before the Synapsis Club, Calif. U., Dec. 3, 1962
(NASA Contract NAS7-100)
(JPL-TR-32-399) OTS: $1.60 ph, $0.80 mf

Current aspects of space science involving soil studies are presented, including a more detailed soil study program involving the microflora of desert soil ecosystems. Basic precepts are given for preparation, investigation, and use of extraterrestrial soil. Author

N63-13713 National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
REMARKS ON HILL'S LUNAR THEORY. PART I
Karl Stumpff Washington, NASA, Mar. 1962 16 p 2 refs
(NASA TN D-1540) OTS: $0.50

In this paper, the Hill equation is modified to give a third-order differential equation for r(the planetocentric distance of the satellite). This equation can be solved by iteration (if the satellite orbit is considered to be a disturbed Kepler ellipse). This new solution is not only suitable for computer applications, but it is independent of the coordinate system and is valid for both a fixed and a rotating system, whereas Hill's solution was limited to simple-periodic orbits in a rotating system. The discussion of Hill's lunar problem provides a simple example of a method applicable also to more difficult problems, such as the restricted three-body problem, in which conic-section orbits can be considered good approximate solutions.
Author

N63-13714 National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
REMARKS ON HILL'S LUNAR THEORY. PART II
Karl Stumpff Washington, NASA, Mar. 1963 15 p 2 refs
(NASA TN D-1541) OTS: $0.50

In 1879, G. W. Hill, using his differential equation system, found a series of direct lunar orbits, which represent a simplification of the restricted three-body problem (neglecting solar parallax and eccentricity). In the present discussion, Hill's coefficients are successively determined from linear equations and are in the form of closed trigonometric expressions. Although this method, which does not extend beyond the third order, is only an interesting attempt at achieving the same goal via a different mathematical route, it does not extend as far as Hill's method (which may be carried out to the fifth or sixth order without difficulty). Author

N63-13723 National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
THE CRITICAL INCLINATION PROBLEM IN SATELLITE ORBIT THEORY
William A. Mersman Washington, NASA, 1962 32 p 11 refs
(NASA TR R-148) GPO: $0.40

Solutions of the satellite orbit problem are obtained that do not exhibit singularities at the critical inclination angle. Series representations are obtained, their regions of convergence are exhibited, and quantitative measures of their speeds of convergence are provided for use in numerical computations. Author

N63-13740 High Altitude Observatory, Boulder, Colo.
THE MAGNETIC FIELD OF JUPITER Scientific Report No. 1
James W. Warwick Dec. 1962 20 p Lecture before AAS, Dec. 29, 1961
(Contract AF 19(628)-224)
(AFCRL-62-721)

The observations and interpretations of radio emissions from Jupiter are studied to determine what bearing the emissions have on the planet's magnetic-field configuration and strength. The observations made confirm the original suggestion of Drake that the high-frequency source results from synchrotron emission by electrons surrounding Jupiter in a situation closely resembling the terrestrial Van Allen Belts. Either the low- or high-frequency observations unambiguously indicate the presence of Jupiter's magnetic field, which leaves an unmistakable imprint in the form of the polarization phenomena in the two widely separated frequency ranges. The computations made are geometric and include the oblate spherical surface of Jupiter as well as a complete three-dimensional structure of the dipole magnetic field. J.R.C.

N63-13753 Rensselaer Polytechnic Inst., Troy, N.Y.
CHEMISTRY OF THE ATMOSPHERE OF THE PLANET VENUS Technical Status Report No. 1, 1 August 1962-31 January 1963
P. Harteck, R. R. Reeves, Jr., and Barbara A. Thompson [1963] 11 p 24 refs
(NASA Grant NsG-261-62; R.P.I. Proj. 441.68)
OTS: $1.60 ph, $0.80 mf

Chemical processes occurring in the Venus atmosphere are explored, with attention being given to carbon dioxide as the only major atmospheric constituent detected to date. The following areas are investigated in detail: radiation chemistry of CO_2; absorption spectra; microwave emission; and CO_2 regeneration. A.R.B.

N63-13767 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
THERMAL PROPERTIES OF A SIMULATED LUNAR MATERIAL IN AIR AND IN VACUUM
E. C. Bernett, H. L. Wood, L. D. Jaffe, and H. E. Martens Nov. 25, 1962 23 p 11 refs
(NASA Contract NAS7-100)
(JPL-TR-32-369) OTS: $2.60 ph, $0.89 mf

The thermal diffusivity and thermal conductivity for a crushed olivine basalt were determined from transient state data. Values were obtained over a temperature range of −100° to 200° C in vacuums of 5×10^{-3} and 5×10^{-6} mm Hg as well as at atmospheric pressure. A −150 mesh material at a density of 1.14 g/cm^3 had a thermal conductivity of 3.9×10^{-6} cal/cm sec °C at 100° C when measured in a vacuum of 5×10^{-6} mm Hg. This was approximately one hundred times lower than the values obtained for the same material measured at atmospheric pressure. Increasing the density to 1.57 g/cm^3 increased the thermal conductivity by approximately 60% in both air and vacuum. Over the range studied, the test temperature had very little effect on thermal conductivity in air but showed more of an effect when the material was placed in a vacuum. Author

N63-13775 Academy of Sciences (USSR). Commission on the Study of the Sun, Moscow
THE PHYSICS OF SOLAR CORPUSCULAR STREAMS AND THEIR INFLUENCE ON THE UPPER ATMOSPHERE OF THE EARTH (FIZIKA SOLNECHNYKH KORPUSKULIARNYKH POTOKOV I IKH VOZDEISTVIE NA VERKHNIUIU ATMOSFERU ZEMLI)
[1957] 144 p refs Moscow, Izd. Akad. Nauk SSSR, 1957 p 8-39, 40-50, 69-86, 144-158, 167-181, 261-268

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1. DISCUSSION OF THE POSSIBLE SOURCES OF GEOACTIVE CORPUSCLES IN THE SOLAR ENVELOPE (OBSUZHDENIE VOZMOZHNYKH ISTOCHNIKOV GEOAKTIVNYKH KORPUSKUL V OBOLOCHKE SOLNTSA) E. R. Mustel' p 1-56 36 refs (See N63-13776 08-29)
2. SPECTROSCOPIC INVESTIGATION OF CORPUSCULAR EJECTIONS ON THE SUN (SPEKTROSKOPICHESKOE ISSLEDOVANIE KORPUSKULIARNYKH VYBROSOV NA SOLNTSE) A. B. Severnyi p 57-72 2 refs (See N63-13777 08-28)

3. SOLAR CORPUSCULAR RADIATION AND THE TOPOLOGY OF THE MAGNETIC FIELD IN THE SOLAR CORONA (KORPUSKULIARNOE IZLUCHENIE SOLNTSA I TOPOLOGIIA MAGNITNOGO POLIA V SOLNECHNOI KORONE) E. A. Ponomarev p 73-80 9 refs (See N63-13778 08-28)
4. DISCUSSIONS ON THE LECTURES OF E. R. MUSTEL', A. B. SEVERNYI, S. K. VSEKHSVIATSKII ET AL., G. M. NIKOL'SKII, E. A. PONOMAREV, AND K. P. STANIUKOVICH p 81-93 (See N63-13779 08-28)
5. MAGNETIC DISTURBANCES IN THE REGION NEAR THE POLE AND THE EXISTENCE OF A SECOND ZONE OF THEIR INCREASED INTENSITY (MAGNITNYE VOZMUSCHENIIA V OKOLOPOLIUSNOI OBLASTI I SUSHCHESTVOVANIE VTOROI ZONY IKH POVYSHENNOI INTENSIVNOSTI) A. P. Nikol'skii p 94-111 (See N63-13780 08-28)
6. THE CONNECTION BETWEEN SOLAR ACTIVITY AND GEOMAGNETIC DISTURBANCES (O SVIAZI MEZHDU SOLNECHNOI AKTIVNOST'IU I GEOMAGNITNYMI VOZMUSHCHENIIAMI) A. I. Ol' p 112-120 17 refs (See N63-13781 08-28)
7. DISCUSSIONS ON THE LECTURES BY A. O. BURDO AND A. I. Ol', A. P. Nikol'skii, V. I. Krasovskii, and K. K. Fedchenko p 121-125 (See N63-13782 08-28)
8. HYDROGEN RADIATION IN THE SPECTRUM OF POLAR AURORAE (O VODORODNOM IZLUCHENII V SPEKTRE POLIARNYKH SIIANII) S. I. Isaev p 126-129 (See N63-13783 08-12)
9. THE EQUATION OF QUASISTATIONARY IONIZATION EQUILIBRIUM IN THE F- REGION AND SOLAR CORPUSCULAR RADIATION (URAVNENIE KVASISTATSIONARNOGO IONIZATSIONNOGO RAVNOVESIIA V OBLASTI F2 I KORPUSKULIARNOE IZLUCHENIE SOLNTSA) E. I. Mogilevskii p 130-139 (See N63-13784 08-28)

N63-13776 Academy of Sciences (USSR). Commission on the Study of the Sun, Moscow

DISCUSSION OF THE POSSIBLE SOURCES OF GEOACTIVE CORPUSCLES IN THE SOLAR ENVELOPE (OBSUZHDENIE VOZMOZHNYKH I STOCHNIKOV GEOAKTIVNYKH KORPUSKUL V OBOLOCHKE SOLNTSA)

E. R. Mustel' *In its* The Physics of Solar Corpuscular Streams and Their Influence on the Upper Atmosphere of the Earth [1957] p 1-56 36 refs (See N63-13775 08-29)

Methods of studying corpuscular streams are explained as follows: (1) comparison of the different formations and phenomena in the solar envelope with geomagnetic and ionospheric disturbances, amplifications and attenuations of the intensity of cosmic rays and other effects on the earth; (2) attempts at direct spectroscopic detection of corpuscular streams enroute from the sun to the earth; and (3) study of the possible mechanisms of ejection of atoms from the sun and their further study. R.C.M.

30 SPACE VEHICLES

Includes: launch vehicle—spacecraft combinations; operating problems; and stability and control.

For manned space capsules, satellites, and space probes see: 32 Space Vehicles (Spacecraft).

For boosters and rockets see: 31 Space Vehicles (Launch Vehicles).

For related information see: 04 Aircraft; 08 Communication; and 22 Navigation and Guidance.

N63-13741 Aerojet-General Corp. Advanced Development Div., Sacramento, Calif.

SEA LAUNCH AND RECOVERY OF VERY LARGE ROCKET VEHICLES

J. M. Armstrong and P. L. Mullins [1962] 232 p 7 refs Presented at the IAS National Meeting on Large Rockets, Sacramento, Oct. 28-31, 1962

The advantages of increasing launch vehicle size are discussed. Very large rocket vehicles seem to have certain important advantages in simplicity, reliability, and economic effectiveness. As vehicle size increases, water-based transportation is necessary and logical. A concept which is completely ocean based is presented. The launch vehicle, designated Sea Dragon, is transported, launched, and recovered in a sea environment. System design philosophy emphasizes simplicity and reliability as the best approach to optimizing economic factors since minimum payload delivery costs are essential to future large-scale space programs. Sea Dragon vehicle-design concepts are presented in some detail, and a first approximation cost analysis is included. A passive vehicle-recovery concept is presented with preliminary technical design considerations. Payload performance for the recovery system is compared with a nonrecoverable system. Author

31 SPACE VEHICLES (LAUNCH VEHICLES)

Includes: boosters; clustered rockets; and multistage rockets.

For propulsion engines see: 27 Propulsion.

For launch vehicle - spacecraft combinations see: 30 Space Vehicles.

For related information see: 04 Aircraft; 08 Communications; and 22 Navigation and Guidance.

N63-13548 National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

PERFORMANCE AND SOME DESIGN ASPECTS OF THE FOUR-STAGE SOLID-PROPELLANT ROCKET VEHICLE USED IN THE RAM A1 FLIGHT TEST

Jack Levine Washington, NASA, Mar. 1963 50 p 10 refs (NASA TN D-1611) OTS: $1.25

A general description, some details of mechanical design and construction, and performance (including angle of attack of the rolling last stage) of a four-stage solid-propellant rocket system used in the RAM (Radio Attenuation Measurement) A1 flight test are presented. The fourth stage attained a maximum velocity of 17,800 feet per second at an altitude of 175,000 feet. Temperature data on the nose cone are also discussed. Author

N63-13637 Martin Co., Baltimore, Md.

LUNAR LANDING MODULE STUDY. LANDING DYNAMICS

W. R. Forlifer Mar. 1962 32 p 3 refs (Tech. Memo. 22; ER-12298)

Two different analytical methods have been used to evaluate the stability characteristics of the landing vehicle with its associated landing gear in order to obtain a check on the results and to utilize the advantages of each method in future optimization studies. The first is a two-dimensional impulse-momentum method which has been programed for the digital computation of stability in both the uphill and downhill directions. The second method is an analog simulation of the two-dimensional rigid-body equations-of-motion. In addition to stability information, this method gives time histories of the stroke in each landing leg. Two types of gear have been considered in the analyses to date: a fixed quadripod and a vertical adjusting octapod.

The fixed gear is the more conventional type where each leg acts individually to absorb the landing energy. The vertical adjusting gear has the capability of free retraction until all legs have contacted the surface before energy absorption begins simultaneously in all legs. The results of both analytical methods indicate that friction coefficients beyond about 0.60 have no effect on stability. Also, results of calculations, obtained by both methods, for the radial spread required for stability agree quite closely. The maximum strokes have a very asymmetric distribution. In a typical landing condition, one of the four landing legs absorbed over 50% of the total energy. Author

32 SPACE VEHICLES (SPACECRAFT)

Includes: manned space capsules; satellites; and space probes.

For boosters and rockets see: 31 Space Vehicles (Launch Vehicles).

For Launch vehicle—spacecraft combinations see: 30 Space Vehicles.

For related information see: 04 Aircraft; 08 Communications; and 22 Navigation and Guidance.

N63-13475 Smithsonian Astrophysical Observatory, Cambridge, Mass.

CATALOGUE OF SATELLITE OBSERVATIONS, NO. C-28

Beatrice Miller June 25, 1962 61 p

(NASA Grant NsG-87-60)

(SAO Special Rept.-96) OTS: $6.60 ph, $2.03 mf

Satellite observation data on Explorer I, Vanguard II, Vanguard II rocket, Vanguard III, and Explorer VII are presented. Observations listed include those from the Smithsonian Astrophysical Observatory Baker-Nunn camera stations and Moonwatch teams, U.S. and foreign observatories, military installations, phototrack stations, and miscellaneous observers. The data given include the date of the observation; the time (universal time); the right ascension time; and the declination, azimuth, and altitude. I.v.L.

N63-13537 National Aeronautics and Space Administration, Washington, D.C.

EXPLORER XVI, THE MICROMETEOROID SATELLITE

Washington, NASA. Office of Educational Programs and Services [1963] 4 p

(NASA FACTS-A-1-63) GPO: $0.10

Satellite measurements, launch and orbital data, and spacecraft experiments of Explorer XVI, the micrometeoroid satellite, are described. Sent into orbit December 16, 1962, Explorer XVI transmits data relating to the number of micrometeoroids encountered, the force with which they bombard the satellite's structure, their destructive effect, and the comparative resistance of different thicknesses and types of materials to penetration by the micrometeoroids. Analysis of data sent by Explorer XVI, during its first month in orbit, conclusively established that micrometeoroids can puncture thin surfaces. Until the satellite furnished this evidence, the hazard posed to spacecraft was presumed but not proved. B.J.C.

N63-13587 National Aeronautics and Space Administration, Washington, D.C.

NASA CONSIDERS DATA COLLECTION SATELLITE SYSTEM News Release No. 63-55

Mar. 17, 1963 3 p

The NASA is considering a new family of "practical" satellites that will collect data from remote areas of the earth. A survey will be made to determine the interest in such a system. Some of the promising areas of application include data collection for oceanographer from surface buoys and for meteorologists from isolated ground stations or from a network of small balloons. The Future Applications Satellites Unit was established as a function of the NASA Office of Applications to study these and other promising new practical uses for satellites and to develop those which are justified. R.C.M.

N63-13651 National Aeronautics and Space Administration, Washington, D.C.

RELAY OPERATING AGAIN News Release No. 63-56

Mar. 14, 1963 5 p

Relay, the National Aeronautics and Space Administration communications satellite, has responded satisfactorily to its "rest" therapy and is operating again. According to NASA, the spacecraft suffered from a severe power drain on March 9, after Relay's orbit had been in the earth's shadow for the preceding five weeks and the spacecraft's temperature was quite low. When the satellite was again exposed to constant sunlight, the temperature limit of the voltage regulator switch in communications Unit One (duplicate communications systems are built into the spacecraft) was exceeded. Relay was turned off and rested and the temperature dropped to the point where the switch opened and the power drain ceased. The satellite was put into operation again on Wednesday, March 13. Signals received from Relay indicated that the power supply voltage and the spacecraft's temperature were again within normal operating limits. The first telemetry data was received about 10 P.M. EST Wednesday as the Relay made its 702nd orbit of the earth. B.J.C.

N63-13738 National Aeronautics and Space Administration, Washington, D.C.

S-6, AN AERONOMY SATELLITE

R. Horowitz [1962] 24 p Presented at the Special Astronautics Symp. on Scientific Satellites—Mission and Design, Phila., Dec. 27, 1962

(AAS-62-81) OTS: $2.60 ph, $0.92 mf

A review is given of the mission and design considerations of S-6, one of NASA's scientific earth satellites, which is instrumented to obtain data that will improve our understanding of the physical and chemical processes occurring in the upper atmosphere betwen 250 and 900 kilometers. After a description of the primary and secondary objectives of the flight, a discussion is presented of: the neutral mass spectrometers, vacuum gages, and electrostatic probes which together comprise the primary detectors; the spacecraft and ancillary flight equipment including the primary power supply, attitude measuring equipment, telemetry, ground support and command system; and the environment test conditions. Author

33 STRESSES AND LOADS

Includes: fatigue; vibration; flutter; and structural tests.

For related information see: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; 03 Aerodynamics of Wings and Control Surfaces; and 34 Structural Design.

N63-13430 Polytechnic Inst. of Brooklyn, N. Y.
COMPARISON OF ELASTICITY AND SHELL THEORY SOLUTIONS FOR A CIRCULAR CYLINDRICAL SHELL SUBJECTED TO PERIODICALLY SPACED BAND LOADS
Jerome M. Klosner and Richard Herman Dec. 1962 65 p 14 refs
(Contract Nonr-839(17))
(PIBAL-658)

The problem of an infinite, circular, cylindrical shell subjected to periodically spaced band loads is investigated using three-dimensional elasticity theory, the classical shell theories of Timoshenko (or Donnell) and Flügge, and two shear-deformation shell theories of the Timoshenko and Flügge type. It is interesting to note that for the case of axisymmetry, the Donnell equations reduce to the Timoshenko equations. The detailed comparison of the resulting stresses and displacements is carried out for ratios of inner-to-outer-shell radii equal to 0.7, 0.8, 0.87, 0.9 and 0.93, and for a ratio of distance between band loads to outer shell diameter equal to 0.2. The ratio of bandwidth to distance between band loads is also equal to 0.2. The Poisson's ratio used is equal to 0.3, and the transverse shear coefficient was taken to be equal to 5/6. Author

N63-13431 Rensselaer Polytechnic Inst. Interdisciplinary Materials Research Center, Troy, N. Y.
ULTRASONIC MEASUREMENTS OF ELASTIC PROPERTIES OF SMALL SPECIMENS AT HIGH PRESSURE Contribution No. 13
Samuel Katz N. Y., Am. Soc. Mech. Eng. [1962] 10 p 14 refs
Presented at the ASME Winter Annual Meeting, N. Y., Nov. 25-30, 1962
(NASA Grant NsG-100-60)
(ASME Paper 62-WA-289) ASME: $0.50 members, $1.00 nonmembers

The pressure dependence of density and elastic constants of materials may be measured in a Bridgman anvil-type pressure cell with ultrasonic pulse-interference methods. Simultaneous determination of longitudinal and transverse wave velocities in the compressed specimen as a function of pressure permits calculation of the pressure derivative of the density, which may be integrated to give the density. Theory, experimental procedure, and results from previously published work are described. Author

N63-13437 Alfred U. New York State Coll. of Ceramics
ISOTROPIC ELASTIC MODULI OF MgO AT THEORETICAL DENSITY POINT Fifth Report
Dae-Hyun Chung, Joseph J. Swica, and William B. Crandall Jan. 15, 1963 23 p 19 refs
(Contract DA-31-124-ARO(D-23))
(AROD-2891-5)

The three elastic-stiffness constants of synthetic Periclase were determined in the kcps frequency range by a resonance method. The values obtained are:

$$c_{11} = 28.92, c_{12} = 8.79, \text{ and } c_{44} = 15.46 \times 10^{11}$$

in dynes per cm^2. The calculated isotropic elastic moduli for polycrystalline MgO obtained from the single-crystal compliances are in good agreement with experimental values measured on dense MgO at the theoretical density point. The measured Young's modulus and the shear modulus of polycrystalline MgO are found to be 30.50 and 12.90×10^{11} in dynes per cm^2. The results of the present investigation are compared with the earlier work in the mcps frequency range. Theoretical analysis is made to establish the validity of the present work. Author

N63-13445 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
AN EXPERIMENTAL METHOD TO MEASURE THE STRAIN ENERGY FUNCTION W
A. San Miguel Dec. 20, 1962 26 p 14 refs
(NASA Contract NAS7-100)
(JPL-TR-32-365) OTS: $2.60 ph, $0.98 mf

An experimental method to determine the strain energy function W in three dimensions for any medium has been presented. No assumptions regarding the medium's physical properties are necessary to obtain the new nonlinear physical property W. The strain energy function for a relatively low-modulus elastomer densely packed with crystals (80%) appears to be defined by

$$W = \text{I-O}(I_1 - 3) + \text{II}(I_2 - 3) + \text{N}(I_3 - 1)$$

where I-O, II, and N are the leading partial derivatives in a Taylor's expansion of $W(I_1 I_2 I_3)$ about the point $I_1 = 3, I_2 = 3, I_3 = 1$, for $W = 0$. Conventional uniaxial experimental data independently confirm the magnitude of the strain energy function obtained from the above equation. Author

N63-13473 Stanford U., Calif.
BUCKLING OF A THIN-WALLED CIRCULAR CYLINDRICAL SHELL HEATED ALONG AN AXIAL STRIP
Nicholas J. Hoff, Chi-Chang Chao, and Wayne A. Madsen Sept. 1962 28 p 5 refs
(Grant AF-AFOSR-62-146)
(SUDAER-142)

The elastic stability of a thin-walled circular cylindrical shell is investigated by means of the small-deflection theory when the shell is subjected to such non-uniform heating as causes a uniform axial compressive stress to arise in a band of width 2b while the rest of the shell is free of stress. The critical value of the compressive axial stress is found to be equal to the critical stress of the same circular cylindrical shell when subjected to uniform axial compression, provided the band is not extremely narrow. In the latter case, the critical stress of the band is higher than that of the uniformly compressed shell. Author

N63-13490 Southampton U. (Gt. Brit.)
THE DAMPING OF ALUMINUM HONEYCOMB SANDWICH BEAMS [Summary Report, July 1960-Nov. 1961]
D. J. Mead and G. R. Froud Wright-Patterson AFB, Ohio, Directorate of Materials and Processes, Jan. 1963 32 p 6 refs
(Contract AF 61(052)-504)
(ASD-TDR-62-1096)

The various sources of damping in a transversely vibrating plate of honeycomb construction are considered, and an expression is derived for the total damping ratio of an unjointed honeycomb sandwich beam. It is shown that the energy dissipation by reason of bending strain in the adhesive layer is of major importance. A damping parameter is defined whereby the amount of damping supplied by bending energy loss in the adhesive may be predicted for a given adhesive layer. Nonlinearity of the adhesive damping is taken into account. The parameter and the nonlinear coefficients have been derived experimentally from tests on honeycomb sandwich beams. For large wavelength vibrations, it has been found that the damping ratio of an unjointed beam or plate is inversely proportional to the skin thickness, showing that the adhesive bending loss is the predominant source of damping. The low values of damping measured (.01% to .04% of critical) suggest that the contributions of the material and adhesive of a honeycomb plate structure to the total damping will be very small compared with the contributions expected from the joints at the panel boundaries. Author

N63-13495 Southampton U. (Gt. Brit.)
RANDOM EXCITATION OF A SIMPLE PANEL, SOME EXPERIMENTAL RESULTS Technical Note No. 3
J. F. Wilby Jan. 1963 26 p 5 refs
(Contract AF 61(052)-358)
(AASU-231)

A steel panel, 3½ inches square and 0.010 inch thick, has been subjected to three forms of random excitation: boundary layer pressure fluctuations, grazing incidence acoustic plane waves, and noise from an air jet. The panel displacements were measured for the

three excitations, and the response spectra are compared. In all cases the spectra are dominated by the response at the panel fundamental frequency. The modal admittance is found to depend on the type of excitation, a dependence which can be explained by considering the correlation lengths associated with the excitations.
Author

N63-13496 General Electric Co. Vallecitos Atomic Lab., San Jose, Calif.
SLOW CYCLE STRAIN FATIGUE IN THIN WALL TUBING Preliminary Report
M. B. Reynolds AEC Div. of Tech. Inform., July 19, 1962 23 p 6 refs
(Contract AT(04-3)-189)
(GEAP-3983) OTS: $0.50

A technique has been developed for slow-cycle strain-fatigue testing using specimens of thin-wall tubing of the type under consideration for use as superheat fuel cladding. Data on type 304 stainless steel have been obtained under radiation and in the absence of radiation. The strain-cycle fatigue life of this alloy at 1200° to 1300° F is decreased threefold by the presence of a neutron flux of $1.5 \times 10^{14} > 1$ Mev. Out-of-reactor data have been obtained on Inconel at 1300° F.
Author

N63-13503 Defense Metals Information Center, Battelle Memorial Inst., Columbus, Ohio
A DISCUSSION OF THE FRACTURE TOUGHNESS OF SEVERAL STAINLESS STEELS IN SHEET FORM
F. J. Barone and A. M. Hall Jan. 31, 1963 35 p 13 refs
(Contract AF 33(616)-7747)
(DMIC-Memo-164)

The role of fracture toughness in the evaluation of materials for supersonic transport skins is discussed along with the data for the following stainless steels: PH 15-7Mo, PH 17-7, PH 17-4, AM 350, AM 355, AM 357, Types 410, 301, 304L, 310 stainless, and 12MoV. The problem of corroborating fracture toughness data is considered, and the need is shown for a standard testing method. It is concluded that, while the available data is valuable for screening purposes, final evaluation of fracture toughness should be made by tests at high temperatures and under cyclic loading conditions.
R.C.M.

N63-13505 Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
DYNAMIC RESPONSE AND TEST CORRELATION OF ELECTRONIC EQUIPMENT [Final] Technical Documentary Report [July 1961 to April 1962]
Denis U. Noiseux, James J. Coles, Norman Doelling, and Gideon Maidanik Wright-Patterson AFB, Ohio, Directorate of Engineering Test, Aug. 1962 130 p 13 refs
(Contract AF 33(616)-7743)
(ASD-TDR-62-614)

A new theory for estimating the response of a complex structure is reviewed. This theory is based on a modal energy balance between the excitation and the structure. The theory is general enough to apply to vibration excitation as well as to acoustic excitation. The theory is applied to a simple structure, a box, simulating an electronic package excited by a reverberant acoustic field, and is verified for this case by experiments. Some refinements of the experimental technique are indicated. A formulation of the equivalence between vibration testing and acoustic testing is offered. The importance of developing such a formulation is demonstrated by showing the economy resulting from its application. The report also presents criteria for specifying acoustic tests. In particular, the dimensions and power requirements of reverberant room test facilities are derived. Experimental results justify the derivations. Results of vibration tests of a microelectronic circuit and a field-effect transistor are given.
Author

N63-13522 German-French Research Inst., Saint-Louis (France)
FLASH RADIOGRAPHIC MEASUREMENT OF THE SHOCK COMPRESSIBILITY OF MAGNESIUM ALLOY, LUCITE, AND POLYETHYLENE
R. Schall and G. Thomer Kirtland AFB, N. Mex., Res. Directorate, Oct. 1962 28 p 11 refs
(Contract AF EOAR Grant 61-52)
(AFSWC-TDR-62-134)

Compressibilities of magnesium alloy, lucite, and polyethylene were measured during explosively induced shock, using a flash X-ray technique. Measurements on magnesium alloy confirm earlier results from a similar experiment using small explosive charges, but show a distinctly lower compressibility than those using free surface measurements. To a lesser extent, the lucite data show the same discrepancy. Polyethylene is less compressible than lucite under intense shock loads.
Author

N63-13540 Florida U. Engineering and Industrial Experiment Station, Gainesville
APPLICATION OF SHALLOW SHELL THEORY TO EQUILIBRIUM AND BUCKLING PHENOMENA Final Report
William A. Nash Oct. 1962 8 p
(Grant DA ORD-31-124-61-G19)
(AROD-2028-14)

The general problem area investigated was that of statics and dynamics of thin, elastic, shallow shells. One of the main difficulties associated with the finite-deflection analysis of such problems lies in the fact that the governing equations are coupled. In an earlier work, approximate equations that were uncoupled were developed. These basic equations were applied to several boundary-value problems, and the analytical results were found to be in excellent agreement with experimental data obtained in the course of this study. An analytical and experimental investigation was conducted of the stabilizing effect of a soft elastic core contained within a thin shell. It was demonstrated that even a very flexible core greatly increased the resistance of the shell to buckling. An analysis was made of stresses in (a) conical shells of variable wall thickness and (b) shells of revolution of negative Gaussian curvature subject to an arbitrary thermal field. Analytical and experimental studies were carried out to investigate the behavior of thin cylindrical shells subject to rapid loadings so that buckling occurs in a time interval of the order of magnitude of milliseconds. For an axially compressed cylinder, for example, it was found that even moderately rapid loading increases the postbuckling resistance by approximately 50 percent over the static value.
Author

N63-13543 Massachusetts Inst. of Tech., Cambridge
STRESS WAVE PROPAGATION AND SPALLATION IN UNIAXIAL STRAIN [Final Report, Mar. 1959 to Mar. 1962]
Walter Herrmann, Emmett A. Witmer, John H. Percy, and Arlon H. Jones Wright-Patterson AFB, Ohio, Directorate of Aeromechanics, Sept. 1962 137 p 41 refs
(Contract AF 33(616)-6373)
(ASD-TDR-62-399)

A discussion of the analytical methods of predicting uniaxial stress wave propagation and spall as a result of uniformly distributed, intense impulsive loading is given. For the materials for which data currently exists, no strain-rate effects are observed on yield (i.e., two aluminum alloys) and the strain-rate effect on the fracture threshold is found to be small (copper). For such materials, a detailed analytical treatment is possible once the constants associated with the constitutive equation and fracture criterion are evaluated. The plate-impact experiment provides a convenient means of evaluating these constants. Considerations entering into the interpretation of the plate-impact experiment and a detailed analysis of the effect of air between the impacting plates are given.
Author

N63-13661 Lehigh U. Inst. of Research, Bethlehem, Pa.
PROPAGATION OF ELASTIC AND PLASTIC STRAIN PULSES IN BOUNDED SOLIDS Final Report, 1 Sept. 1961 to 31 Aug. 1962
C. W. Curtis [1962] 21 p 8 refs
(Contract DA-ARO(D)-31-124-G126)
(AROD-1325-16)

The propagation of strain in bounded solids has been the subject of investigation at Lehigh University since 1951. This report reviews the background and results of the completed phases of the program and outlines the studies now in progress. Author

N63-13669 Douglas Aircraft Co., Inc. Missile and Space Systems Div., Santa Monica, Calif.
FOR THE SPACE AGE. A BIBLIOGRAPHY OF SANDWICH PLATES AND SHELLS
J. I. Foss Dec. 1962 104 p 838 refs
(SM-42883)

This bibliography is comprised of 838 papers and books on theoretical and experimental stress analysis of sandwich constructions, i.e., plates and shells. Core-to-face attachments, design applications, fabrication methods, mechanical properties, testing procedures, and inspection methods are considered to be an inherent part of the problem of analysis, and references to papers on these phases of the work are therefore included. The main section index, subject index, and author index are cross-referenced. The listing is believed to be current through November 1962. Author

N63-13701 General Applied Science Labs., Westbury, N.Y.
AXISYMMETRIC THERMAL AND PRESSURE-INDUCED STRESSES IN A SINGLE OR DOUBLE-LAYER, THICK SHELL OF REVOLUTION COMPOSED OF ANISOTROPIC, INHOMOGENEOUS MATERIALS
F. Lane and D. Magnus Dec. 27, 1962 39 p 3 refs
(Contract Nord-18053)
(GASL-TR-284)

An analysis is developed for the numerical computation of thermal and pressure-induced stresses in thick, blunt-nosed shells of revolution of one or two layers of constant thickness. In the single-layer case, the shell is assumed orthotropic with a single preferred direction, this direction being normal to the shell surface. In the double-layer configuration, only the outer layer is orthotropic, with the same single preferred direction orientation; and the inner layer is isotropic. The analysis utilizes polynomial approximations to the displacement distributions and a weighted integral solution technique somewhat akin to a partial Galerkin method. The result of the weighted-integral method is a system of coupled second-ordered ordinary differential equations for the coefficients in the displacement polynomials, with meridional coordinate as independent variable. The resulting (large-scale) system is tridiagonal with respect to submatrices whose order depends on the order of the z-polynomial approximations to displacements. J.R.C.

N63-13717 National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
POSTBUCKLING EFFECTS ON THE FLUTTER OF SIMPLY SUPPORTED RECTANGULAR PANELS AT SUPERSONIC SPEEDS
Robert W. Fralich Washington, NASA, Mar. 1963 31 p 16 refs
(NASA TN D-1615) OTS: $0.75

A theoretical analysis is given for the flutter of simply supported rectangular panels subjected to supersonic flow over one surface. Postbuckling effects of in-plane edge loads and in-plane shortenings on the flutter speed are investigated. The von Kármán large-deflection plate theory is used in conjunction with linearized static aerodynamic strip theory. A Galerkin procedure using the first two static buckling modes is employed to find the flutter criterion for panels with ratios of length in the streamwise direction to half-wavelength in the cross-flow direction between 0 and 2. Author

N63-13732 Materials Research Lab., Inc., Richton Park, Ill.
APPLICATION OF FRACTURE MECHANICS TO ADHESIVE JOINTS Status Report No. 2, April 1962–August 1962
R. L. Patrick (Alpha Res. and Dev., Inc.), E. J. Ripling, and S. Mostovoy [1962] 18 p 3 refs
(Contract Nonr-3544(00) (X))
(Tech Memo-244)

Adhesive toughness was evaluated using the procedures of fracture mechanics in order to establish minimum toughness standards that can be applied to structural materials used in a specific application. Variables examined were: the effect of joint thickness on the opening mode using aluminum adherends and the stability factor involving the relation of joint configurations with ability to arrest crack propagation; the effect of strain rate on fracture toughness of bulk epoxy; the effect of joint thickness on forward shear and on the opening mode; the effect of adherends on toughness; and the appearance of the fracture surface. A.R.B.

N63-13733 Materials Research Lab., Inc., Richton Park, Ill.
APPLICATION OF FRACTURE MECHANICS TO ADHESIVE JOINTS Status Report No. 3, September 1962-December 1962
R. L. Patrick (Alpha Res. and Dev., Inc.,), E. J. Ripling, and S. Mostovoy [1962] 22 p 4 refs
(Contract Nonr-3544(00) (X))
(Tech. Memo- 225)

Fracture toughness of adhesive joints has been measured to determine the effect of joint geometry, strain rate, and surface preparation. Adherends of aluminum, glass, and fiber glass were used in conjunction with an epoxy adhesive. The results of these tests are presented graphically. R.C.M.

N63-13745 Republic Aviation Corp., Farmingdale, N.Y.
STATISTICAL METHODS FOR THE PREDICTION OF SAFE AIRCRAFT FATIGUE LIFE
Herbert Jaffe [1963] 14 p 7 refs Presented at the Aircraft Structural Integrity Program Meeting, Wright-Patterson AFB, Ohio, Feb. 6, 1963
(RAC-1147)

Methods are given for computing the safe fatigue life of aircraft components from the results of fatigue tests which simulate aircraft usage. The predicted ratio of failures to the total number of components in use for a given confidence level is obtained as a function of the scatter factor, which is defined as the ratio of the geometric mean of the sample life to the life at which the components are removed from service. Both the case where the fatigue life standard deviation is estimated from the sample and the case where it is estimated from a large number of similar tests are considered. Author

N63-13751 Mechanical Technology, Inc., Latham, N.Y.
ON FORWARD AND INVERSE ITERATION OF THE ELASTOHYDRODYNAMIC PROBLEM
H. S. Cheng Dec. 13, 1962 28 p 7 refs
(Contract Nonr-3729(00) (FBM))
(MTI-62TR37)

Two numerical iterative procedures are formulated to calculate the pressure, temperature, and film shape of the elastohydrodynamic problem. The first one is known as the direct iteration, intended for the moderately loaded cases, and the second one is called the inverse iteration, which is used for the heavily loaded cases. Both iterations incorporate a normalization procedure previously proposed by Weber and Saalfeld. The normalization greatly reduces the calculation required to cover a given range of parameters. The iterative procedures were developed to remove the following limitations: (1) isothermal restriction, (2) necessity for accurate guesses of pressures between iterations, and (3) speed and load range restriction.

In addition, the convergence for the direct iteration of the isothermal and isoviscous case is analyzed, and the reason why the previous solution in the moderately loaded region cannot be extended to the heavily loaded cases is explained. Author

N63-13752 Mechanical Technology Inc., Latham, N.Y.
SOME COMPUTER RESULTS IN THE DIRECT ITERATION SOLUTION OF THE ELASTOHYDRODYNAMIC EQUATIONS
R. J. Wernick and Paul Lewis Feb. 1963 28 p 8 refs
(Contract Nonr 3729(00))
(MTI-62TR38)

Results of a computer program to solve the elastohydrodynamic equations are presented. The method of solution is applicable to moderately loaded cases. The results check and extend previously published isothermal cases. Also included is a highly accurate method for calculating film-thickness profiles, which corrects a previous erroneous method. The flexibility of the program permits its further use in obtaining solutions of the elastohydrodynamic equations, including thermal effects. Author

34 STRUCTURAL DESIGN

Includes: structural elements; and weight analysis.

For related information see: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; 03 Aerodynamics of Wings and Control Surfaces; and 33 Stresses and Loads.

N63-13370 Wilcox Electric Co., Inc., Kansas City, Mo.
A NEW APPROACH TO AVIATION ELECTRONIC SYSTEM PACKAGING
W. E. Hanneman *In* Radio Technical Commision for Aeronautics, Wash., D.C. Minutes of Fall 1962 Assembly Meeting, Marriott Motor Hotel and the Naval Research Lab., Wash., D.C., Nov. 27-29, 1962 Dec. 5, 1962 5 p (See N63-13356 08-01)
(Paper 183-62/AS-255)

Three possible methods for installing and integrating "Black Boxes" in aircraft are compared. These methods consist of : (1) individually shock mounting and wiring each unit; (2) installing the equipment on shelves and shock mounting each shelf; (3) using an integrated electronic equipment rack. A comparison of the three methods shows that, as far as cost is concerned, use of shock-mounted shelves and the integrated electronic rack are very nearly the same; whereas the individual shock-mounted units normally run approximately twenty percent more. Also, the integrated electronic equipment rack and the shelf system are both lighter than an equivalent installation using an individual shock-mount system. In addition, best reliability and flexibility is obtained with an installation using the integrated electronic equipment rack. B.J.C.

N63-13491 Grünzweig and Hartmann A. -G., Ludwigshafen am Rhein (W. Germany)
STRUCTURAL CONFIGURATIONS FOR INCREASED RESONANCE FATIGUE LIFE [Summary] Technical Documentary Report [July 1961-Sept. 1962]
G. Kurtze Wright-Patterson AFB, Ohio, Directorate of Materials and Processes, Jan. 1963 64 p 6 refs
(Contract AF 61(052)-547)
(ASD-TDR-62-1098)

A short summary is presented of the existing methods used for the damping of bending waves, and an analysis is given for the calculation of three types of sandwich panels with dissipative cores. These sandwich panels seem to represent the optimum solution with respect to high damping and are characterized by equally thick metal-skin layers. The core may be either thin or thick as compared to the skins or may be composed of a thin dissipative layer and a spacer. Experimental data are given as obtained from loss tangent measurements as a function of temperature with sandwich panels of the three types. Author

N63-13492 Naval Research Lab., Washington, D.C.
FACTORS THAT DETERMINE THE APPLICABILITY OF HIGH STRENGTH QUENCHED AND TEMPERED STEELS TO SUBMARINE HULL CONSTRUCTION (Final Report)
W. S. Pellini and P. P. Puzak Dec. 5, 1962 35 p 4 refs
(NRL-5892) OTS: $1.00

An analysis is given of the potentials and limitations of high-strength, quenched, and tempered (Q&T) steels for welded construction of submarine hulls. The explosion tear test is used to estimate the flaw size-fracture stress relationships. Correlations of these data with drop-weight tear test data and other test data provide an indirect assessment of these relationships. These tests cover an extensive range of materials and strength levels. Consideration of these factors leads to the conclusion that Q&T steel hull-fabrication capability at the 120 to 130 ksi yield-strength level may be attained by a short-term development program. The best promise of hull steels with strength levels in excess of 150 ksi is in the development of an entirely new family of materials based on new metallurgical concepts of hardening. Author

N63-13519 Northrop Corp. Northrop Space Labs., Hawthorne, Calif.
SELF-SEALING STRUCTURES FOR CONTROL OF THE METEOROID HAZARD TO SPACE VEHICLES Third Quarterly Report [Oct. 1-Dec. 31, 1962]
Phillip J. D'Anna, Roger M. Heitz, James J. Piechocki, and Richard W. Hunter Jan. 1963 83 p 3 refs
(NASA Contract NASr-102)
(NSL-62-132-2) OTS: $8.10 ph, $2.69 mf

Two panel concepts, one a precompressed elastomer and the other a chemical (bag encapsulation) configuration, were evaluated and their feasibility experimentally verified by puncturing with ⅛-inch-diameter steel spheres at velocities to 7,000 fps. Refinements to two previously reported concepts, the elastomeric spheres and the chemical (separating membrane) configurations, have resulted in improvement of self-sealing action and increased sealing capability. Preliminary dynamic test results, using both steel and lead pellets, indicate that the current configurations of the chemical concepts (separating membrane and bag encapsulation) possess the best capability for sealing against the more severe type of panel damage; whereas the mechanically activated concepts are more sensitive to panel damage and/or material loss during puncturing of the panel. Author

N63-13555 Republic Aviation Corp., Farmingdale, N.Y.
A NONDIMENSIONAL APPROACH TO THE MINIMUM WEIGHT DESIGN OF HOT COMPRESSION STRUCTURE
Harold Switzky Jan. 25, 1963 46 p 10 refs Prepared for Aero-Nautical Nat. Meeting of the Soc. of Automotive Engrs., Inc., and the American Soc. of Naval Engrs., Inc., 1963
(Contract AF 33(657)-7872)
(RAC-973; ARD-967-1; Based on Rept. ASD-TDR-62-763)

The design of hot compression structures is complicated by the various possible stress-strain relationships and structural configurations. A nondimensional design technique is presented in terms of geometric and material parameters which can readily be evaluated

from known boundary conditions, type of construction, and stress-strain data. The design procedure for minimum weight is demonstrated for a heated truss-like spar. Author

N63-13654 Wyman-Gordon Co., Worcester, Mass.

PROPERTIES OF 18% Ni-Co-Mo MARAGING STEEL PRESS FORGINGS

Robert B. Sparks Nov. 1962 30 p

(Tech. Rept. W-G RD 62-156)

Full-scale proof tests of the full-size motor case have proved that 18% Ni maraging steel press forgings are suitable for Pershing motor-case closures. Testing of a typical airframe structural part forged from 18% Ni maraging steel showed equally good results in thin web sections, but ductility falls off significantly in the transverse and short transverse directions of the heavy section. Tensile strength shows good uniformity throughout the forgings. Transverse ductility is influenced by the amount of working during forging. For optimum properties, the forging process must be tailored to these alloys from die design through final press forging and heat treatment. Author

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